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SOUTH AFRICAN PROJECT

RESEARCH PAPER TITLE:

ENVIRONMENTAL IMPACTS OF THE FORESTRY SECTOR IN SOUTH AFRICA WITH SPECIFIC REFERENCE TO WATER RESOURCES

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FOREWORD

That a healthy environment is intrinsic to sustainable development is now generally accepted. However moving beyond mere recognition is more difficult. This includes understanding the dynamics, and myriad environmental, economic and social relationships. Greater insight into the interactions between the macro economy and the environment is critical.

To address the last mentioned this project focused on policy reforms, taking account of environmental issues, at macro economic level and the socio economic implications thereof.

The overall project includes work from four countries, Tanzania, Zambia, Zimbabwe and South Africa, and was initiated by the WWF/MPO (Macroeconomic Programmes Office, Washington DC) with stakeholder groupings in each country. Each country project was managed independently, (in South Africa DBSA acted as Project Secretariat) had its own National Advisory Committee (NAC) while the overall project was guided by an International Advisory Committee (IAC). The overall project has been funded by a variety of international donors. The South African project secretariat and stakeholders acknowledge with great appreciation the funding provided for the South African project by GTZ.

This report is one of a series of ten research working papers and reflects the output of the research element of the SA project. The findings of these reports have also been brought together in a project synthesis report. The project as a whole and in particular the individual papers benefited enormously from the range and diversity of stakeholders involved. However it needs to be acknowledged that this diversity is both a strength and weakness. A strength because of the insights gained from these diverse positions and a potential weakness precisely because of this diversity making it at best difficult and at worst impossible to achieve consensus on all issues. Thus, the papers reflect the research undertaken by eminent people in their particular fields, their interpretation of comments received and discussions held with stakeholders. *But in the end the views expressed are those of the researchers and are not necessarily shared by the DBSA or any other stakeholder.*

DBSA, as the project secretariat, thanks all those involved – the NAC members and in particular the Executive – and sincerely hopes that this report together with the individual research reports will add substance to the debates in environmental economics and extend understanding particularly around the dynamic of macro economics and the environment.

Midrand March 2002

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The water sector: a position paper

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- Guy Pegram – Consultant

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Agriculture, water resources and the macro economy

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An investigation into mining as an energy and water using sector and its environmental impacts

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National Advisory Committee (NAC)

The membership of the NAC, in total some fifty persons, was drawn from a spectrum of stakeholders and interest groups including the public and private sectors, NGO's, university and research establishments. The membership elected the following executive:

- Saliem Fakir (IUCN Pretoria) – Chairperson
- Ester Koch (Department of Environmental Affairs and Tourism, Pretoria)
- Dr Pat Manders (Envirotek, CSIR, Pretoria)
- Gina Roos (Eskom, Johannesburg)
- Glynn Davies (DBSA, Midrand)

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EXECUTIVE SUMMARY

Forestry, like most other land-uses, has an impact on the environment. These impacts are not well-quantified and therefore could not be effectively integrated into macroeconomic policymaking. Negative impacts are streamflow reduction and biodiversity loss, while carbon sequestration is a positive environmental impact. The main objective of this study is to evaluate the monetary costs of forestry=s environmental impacts, with special emphasis on water resources, and to discuss mitigation and policy options.

Forestry contributes roughly 6,3 per cent of the gross value of agricultural products in 1993/94 and the forest products industry made up 7,4 per cent of total manufacturing output in the same year. In 1995/96 forestry comprised approximately 0,28 percent of total GDP. Large owners (Mondi, Sappi, Safcol, DWAF, Masonite and Hans Merensky) manage approximately 73 per cent of forestry plantations, 25 per cent is managed by the medium and small category (primarily private white farmers) and almost 2 per cent through SAWGU, Sappi and Mondi=s grower=s schemes (mini category). There are very few cases of true communal ownership.

According to best national estimates of forestry=s water use based on experiments, hydrology models and GIS applications, the total amount of incremental water used by the forestry industry is approximately 1417 million m; which amounts to approximately 7 per cent of total water use in South Africa. The average water use differs considerably among tree species and rotations. The national average for all species is 934 m;/ha, with an average of 1135 m;/ha for softwood species (pine), 708 m;/ha for eucalypt and 472 m;/ha for wattle.

The opportunity cost of this water use is valued at benefit lost to downstream water users. A variety of opportunity cost estimates from the literature are compared. The variations indicate that the estimations of opportunity costs still need much refinement. As an upper bound estimation, a net-back analysis was employed to determine the maximum willingness to pay (WTP) based on profitability after non-water input costs, subsidies and current water prices have been taken into account. Estimates based on information supplied by the Timber Growers Association indicate that this cost is R0.90 per m^3 across all species. Maximum opportunity costs vary between species, wattle being the highest (R1.05 per m^3) and pine being the lowest (R0.30 per m^3).

The net back approach has also indicated that pine plantations are most sensitive to price increases, followed by eucalypt and wattle. In other words, pine is least likely to be economically viable under high water price increases. Since pine plantations currently constitute approximately 57 percent of total forestry plantations, pricing strategies that negatively impact on this species could have serious financial implications on the forestry sector. On the other hand, current study estimates indicate that pine plantations are the highest water users per afforested hectare, using approximately 1200m^3/ha compared with eucalypt plantations, the next highest water user (748m^3/ha). It is

therefore conceivable for more efficient water use allocations to occur under economic pricing in the forestry sector. The extent to which this is realisable is further subject to biophysical and social constraints.

Apart from the water use impacts of forestry, there is concern about the loss of habitat where plantations have been established. However, the debate is strongly divided, as other land uses have negative impacts as well. This debate is highlighted in the present study but no economic values have been derived for biodiversity loss.

Trees store carbon, the main element responsible for the enhanced greenhouse effect. It is estimated that the value of carbon sequestration could be in the order of tens of millions of Rands, but more specific calculations are required to verify the results. Current lower bound (1998) estimates are comparable with other most recent independent study estimates for 1995/6, based on a similar value per unit carbon sequestered.

The impact of charging for water on the forestry sector and the broader economy is also analysed. The price elasticity estimates the percentage change in the quantity of water used as a proportion of the percentage change in water price. Price elasticities for water are fairly inelastic, especially for irrigated agriculture. The price elasticity for forestry is likely to be even lower, since the possibilities for substitution are remote. The study employed an own price elasticity of demand of -0.4 for forestry sector effects, based on best available national data. The methodology employed to model water pricing effects did not require estimates of the price elasticity of water in forestry.

To determine the impacts of water pricing on the forestry sector and the broader economy, an input-output framework was used. Several scenarios were developed to assess potential policy effects, based on a wide range of opportunity cost estimates for water. The first scenario used the recent proposed raw water price estimates for forestry obtained from DWAF. The second employed the upper bound opportunity cost estimates derived from the net back analysis. And the third scenario calculated the loss in Gross Operating Surplus (GOS) required to reduce profitability in the forestry sector to 0. This was derived from the 1996 Input Output table. Opportunity cost estimates varied from about R0.06 to about R1.8 per m^3 at 1996 prices, following these scenarios. All scenarios indicated an overall decline in output in the forestry sector. This was offset against increased returns (output) in the water sector, in spite of reduced water consumption. Overall, however, the water sector multipliers dominated, resulting in increased economywide output. These results were not sensitive to changes in the elasticity of water. The findings of the policy analysis suggest further scope for efficiency and output gains through full cost pricing in the forestry sector (beyond those currently proposed by DWAF), provided this can be justified politically. Careful consideration needs to be made of the choice of opportunity cost measure.

Although there are many policy options available, the forestry sector, internationally and national have focussed on regulatory approaches. There are many ongoing initiatives in the international arena such as Environmental

Management Voluntary Standards (e.g. ISO14001), the Forest Stewardship Council (FSC) and the Framework Convention on Climate Change (FCCC) which could have direct implications for South African plantation forestry. National policy for forestry has focussed on regulative approaches such as the enforcement of riparian zones and forestry certification schemes. Economic policy instruments, such as water pricing can play a role in providing the incentives for more efficient water use. Even when it is assumed that there are few substitution possibilities forestry, results from policy simulations on price increases indicate that economywide output (growth) benefits are likely to arise.

The internalisation of water use externalities is only one way to use economic instruments. The use of the so-called efficiency criteria are a necessary, but not sufficient condition to reach a path of sustainable development. The removal of current distortions (e.g. subsidies, tariffs etc) and structural macroeconomic reform towards economical, ecologically and socially sustainable development are also policy options that need to be kept in mind.

It can be concluded that while forestry does have negative and positive environmental impacts, further work is required to refine the quantification of these impacts. Industrial forestry does have an impact on South Africa=s water resources, consuming more than 7 per cent of the total water use. This is almost as much as mining & industrial users, which consume just less than 8 percent. It is recommended that forestry take notice of the potential benefits of carbon sequestration on international markets for carbon rights. These benefits could be in the order of tens of millions of Rands.

Apart from regulatory approaches to forestry, the possibility for market-based instruments, such as water charges, could be considered. Once the political decision has been made, such instruments are relatively efficient to obtain economic objectives of the internalisation of water use externalities. These instruments should, however, not be implemented in the absence of a well-defined institutional context and without (ideally) prior removal of current market distortions. The relationship between >getting the prices right= and structural macroeconomic reform is highlighted as an area where this paper did not pay adequate attention to, but certainly of importance to the broader debate on the macro-economy and sustainable development.

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ENVIRONMENTAL IMPACTS OF THE FORESTRY SECTOR IN SOUTH AFRICA WITH SPECIFIC REFERENCE TO WATER RESOURCES

1. INTRODUCTION

1.1 Problem Statement

Given South Africa=s high dependence on natural capital, it has become increasingly important to assess the impact of key macroeconomic reforms on the environment. One of these reforms is the current shift from subsidised water use, to a water pricing strategy better able to reflect the true economic cost of water. This is important, since South Africa=s water resources are vital to the economic development of the country, the health and prosperity of our people, and the sustenance of our natural heritage. It has been projected that *South Africa will reach the limits of economically usable, land-based fresh water resources in the first half of next century* (DWAF 1997b).

Whilst it may appear at the outset as though full cost pricing would provide a solution to the water scarcity problem by promoting improved efficiency, many other considerations are important and need to be investigated. One of the most important of these is the anticipated impacts on the forestry sector. The activities of this sector have impacts on economic activity, in terms of contributing towards economic growth and foreign exchange earnings. Furthermore, the forestry sector also contributes towards social upliftment, creating jobs and providing opportunities for emerging farmers from previously disadvantaged communities. Thirdly, the activities of the sector and changes in the sector as a result of policy reforms are likely to impact on the environment, both positively and negatively.

Forestry, like most other land-uses, has a significant impact on the environment. These impacts are not well quantified and therefore could not be effectively integrated into macroeconomic policymaking. Negative impacts are streamflow reduction and biodiversity loss, while carbon sequestration is a positive environmental impact.

The impact of plantation forestry on runoff reduction is well documented in scientific work. Forest plantations use more water than the natural vegetation they replace, which results in less water in the river systems (Scholes et al 1995:24). It is listed as a source of increased pressure on the scarce water resources in the country. A series of long-term experiments were conducted in South Africa, in which whole catchments were afforested and the impacts on stream-flow monitored. Estimates of the additional water use by mature pines and eucalyptus range from 300-600 mm/year.

The National Forests Bill in South Africa commits the government to counter the adverse effects of commercial forestry on water resources. The White Paper suggests the institution of user costs to promote the efficient use of water and identifies the need for each major water-use sector to develop a water use, conservation and protection policy supported by regulation (DWAF 1997b: 67).

The forestry sector can be categorised in commercial plantations, small growers and communally owned forestry. It is expected that these different categories have relative different impacts on the environment.

1.2 Objectives

This study will consider the impact of plantation forestry, including large and small growers, and communally owned plantations, on water resources. Biodiversity loss and carbon sequestration will also be discussed, but in less detail. The objectives are to:

< calculate the costs and benefits of environmental impacts for the forestry sector.
< identify and discuss alternative solutions and mitigation options.
< develop policy options for the forestry sector, with a focus on streamflow reduction.

1.3 Method and Approach

The approach is to:

< identify and analyse the impacts of activities within the forestry sector on water use and to a lesser extent biodiversity loss and carbon sequestration;
< identify and discuss possible alternative solutions and mitigating technologies in the forestry sector;
< quantify environmental and social impacts as far as possible using best practice valuation techniques;
< establish elasticity to water price changes in the forestry sector;
< develop policy options.

1.4 Information Issues

There is no single, definitive database of forestry areas in South Africa. The Chief Directorate of Forestry within the Department of Water Affairs and Forestry (DWAF) conducts an annual survey by means of questionnaire of registered timber growers. On the basis of these returns a fairly comprehensive picture of timber growing activity is developed, including crop and product types, areas and production. However, large blocks of woodlots (e.g. on the highveld) have not been considered as part of the forestry area because the owners do not see themselves as being in the forestry business. Also, very many owners of very small plots of decidedly commercial forestry are not all surveyed (largely the new black growers in small grower schemes in KwaZulu-Natal).

The second major database of afforested land is that created by mapping from satellite images, and this provides a relatively reliable spatial database of forestry activity by broad type categories for the whole country (Thompson 1995). In the preparation of this database all plots of less than 25 ha were excluded on the basis that such plots were essentially >non-commercial=. This satellite-derived database does not necessarily agree completely with the formal database of DWAF, though the difference in aggregate areas appears to be small (Le Maitre et al, 1997). In developing estimates of the incremental water consumption by forestry a combination of the databases is used, working to the larger, more up-to-date total area given by DWAF (1,518 million ha), but using the spatial database for the distribution of tree types by province, and the associated water consumption estimates derived by Le Maitre et al (1997).

2. AN OVERVIEW OF THE FORESTRY SECTOR=S IMPACTS ON THE ENVIRONMENT

2.1 The South African Forestry Industry

South Africa has little natural forest, only 0,3 per cent of the land area (Thompson 1999). These forests are small, unproductive and difficult to exploit on a sustainable basis. As a result, plantations of exotic (alien) tree species have been established over the last century to provide for domestic timber, fibre and pulp needs. South Africa now has around 1,5 per cent of its land area under these established timber plantations (Thompson 1999), and this area of trees, because of the productivity of the plantations and their efficient management, makes the country self-sufficient in forestry products.

Commercially viable timber plantations are limited to the humid parts of South Africa, with a mean annual rainfall of 800 mm being taken as a general minimum. Furthermore, plantations have generally been established on agricultural land of very low value by virtue of its poor fertility, poor access and ruggedness (steep, rocky and uneven). Alternative agricultural activities on the same land would typically be managing veld grass for rough grazing, dryland sugar cane and, on limited sites, dryland maize. The trees are established with little site preparation and given a low level of management, which includes weeding, and, in some cases, thinning and pruning (depending on the crop). The rotation length (growing cycle) ranges from as little as eight years (for eucalypts grown for mining timber) to as long as 35 years (for high quality pine sawlogs).

The state, through Safcol, is still the most heavily invested in the longer rotation products of the timber industry, namely pine sawlogs, followed by Mondi Forests. Generally, the smaller the grower the shorter the rotation crop they are invested in. The new generation of black growers are mainly producing eucalypts for pulp along the KwaZulu-Natal coast, on a rotation varying, depending on site between eight and twelve years. The other group of black growers produce wattle for bark, poles and timber, on similarly short rotations. Wattle is most commonly mixed with other agricultural crops (sugar, wattle, maize and eucalypts might be interchanged) and has always been the most popular timber crop with smaller private growers who have the largest area of wattle. Wattle also has the benefit of having multiple products: bark for tannin, poles and logs for chipping.

Forestry contributed roughly 6,3 per cent of the gross value of agricultural outputs in 1993/94 and the Forest Products Industry made up 7,4 per cent of total manufacturing output in the same year (DWAF 1995).

2.2 Forestry Ownership Categories

2.2.1 Background and method

This information was hard to acquire for the following reasons:

< No census is taken on this basis. DWAF=s survey of commercial forestry does not include the new growers who are large in number, particularly in KZN. The DWAF census information is summed up by categories of >private= and >public= ownership. No further breakdown of ownership is given. DWAF rightly consider the questionnaires as confidential information, so only they could generate a different classification of ownership.

< It ought to be relatively easy to obtain the areas under >corporate= ownership in each province because there are so few large companies. This would allow one to account for the bulk of the area with confidence. However, the Forest Owners Association (FOA) does not have the specific information on planted areas by species group and province, and at least one of the large private timber companies is unwilling to share this information.

Table 1: Approximate areas of plantations by province, species group and category of ownership.

Province	Species Group	Land Ownership by Category		
		Large	Med. & Small	Mini
		(ha)	(ha)	(ha)
Eastern Province	Eucalypt	15000	5325	0
	Pine	152500	68760	0
	Wattle	0	3874	0
Free State	Eucalypt	0	650	0
	Pine	0	477	0
	Wattle	0	1423	0
Gauteng	All	0	18	0
KwaZulu-Natal	Eucalypt	190000	20389	18076
	Pine	182000	8229	0
	Wattle	23000	47111	5949
Mpumalanga	Eucalypt	204800	33726	0
	Pine	230500	103835	0
	Wattle	13000	22030	642
Northern Province	Eucalypt	31307	11595	0
	Pine	15000	24695	0
	Wattle	0	3	0
Western Cape	Eucalypt	3000	576	0
	Pine	57000	23386	0
	Wattle	0	263	0
North West	none	0	0	0
Northern Cape	none	0	0	0
Totals		**1 117 107**	**376 364**	**24 667**

To generate the areas of forestry in different categories of ownership, we were therefore forced to approximate, based on what firm data on ownership was available. These were (1) the total figures we have from DWAF=s annual survey of the industry, by species group and province, and additional summary tables from this data provided by the FOA; (2) detailed figures for the wattle industry provided by the SA Wattle Growers Union (SAWGU); (3) In some provinces or regions it is known that all public land is managed by Safcol, and in general public land was classed as falling under large ownership; and (4) the areas under black ownership (and numbers of owners) in the small grower / out-grower schemes of SAWGU, Sappi and Mondi, which information was readily shared. To fill in the rest of the tables the remaining sectors had to be interpolated so as to keep the provincial totals and the totals under the different species groups correct. For an overview of approximate areas of plantations by province, species group and category of ownership see Table 1.

2.2.2 Categories of forestry ownership

2.2.2.1 Large Owners

This class was taken as large companies and plantations managed by DWAF (roughly 1,12 million ha in total); small in number this group essentially comprises Mondi Forests, Sappi Forests, South African Forestry Company Limited (Safcol), DWAF, Masonite and Hans Merensky. Membership of this group therefore implies corporate or state ownership in excess of 10 000 ha.

2.2.2.2 Mini (Very Small)

This is a new class of forest owners: those being encouraged to develop plantations under the SAWGU Small Grower Scheme, Sappi Project Grow and Mondi=s Khulanathi scheme. There are large numbers of growers in these schemes though their individual planted holdings is typically very small: 2 800 owners with an average area of 2,6 ha each under the wattle scheme, 7000 owners with an average of 1,7 ha per owner in Sappi Project Grow, and roughly 3143 owners with 1,9 ha each in three Mondi schemes. As these are a well-defined group about which good statistics were available, they were kept separate.

2.2.2.3 Medium and Small

This was taken as the remainder category, as it is not possible to get complete figures (areas were calculated as the remainder of Total less Large and less Mini), and includes primarily private white farmers (commercial farmers) or farming partnerships. There were an estimated 1 045 of this class of growers with less than 500 ha of forestry each in 1991/92 (DWAF 1993). The more recent DWAF survey gives just 20,2 per cent of commercial forestry s being owned by private individuals and partnerships with average plantings of less than 500 ha each. However, NCT Timber Co-operative (NCT) estimate that they market timber for 3 600 private white growers and 1 800 black growers, the vast majority of which are in KwaZulu-Natal. This latter figure is approximate as it is not always easy to distinguish between growers and contractors. The details of small timber plantation schemes according to numbers of growers and areas under plantation is given in Table 2.

Table 2: Details of small timber plantation schemes giving numbers of growers and area under plantation.

Province	Scheme	Crop	Area (ha)	Numbers
Mpumalanga	SAWGU Small Growers	Wattle for bark, wood and poles	642	20
KwaZulu-Natal	SAWGU Small Growers	Wattle for bark, wood and poles	5 949	2 760
	Sappi Project Grow	Eucalypts for pulp	12 000	7 000
	Mondi (Khulanathi)	Eucalypts for pulp	6 076	3 140
TOTALS			24 667	12 920

Previously small plantings (less than 10 ha) did not require planting permits. Now all growers require permission and this is slowing the growth of the small grower schemes. For plots of less than 10 ha an abbreviated procedure applies, but for all larger plantings the requirements for a permit are fairly demanding. SAWGU have been able to negotiate a general allocation for certain midland catchments, based on an application that detailed the existing plantings and the potential for expansion.

Membership of the private growers organization South African Timbers Growers Association (SATGA) is voluntary, and SATGA have 1 400 members at present. When membership was automatically associated with a roundwood levy, SATGA had around 2 500 members. The NCT numbers do therefore seem somewhat high for actual timber growers.

2.2.2.4 Communal Ownership

This is an awkward category. There appear to be very few cases of true communal ownership and it is difficult to find details of these. We have been convinced that communal ownership is not applicable in any major way in the forest industry, and have therefore not used this category. Small growers falling under tribal authority (virtually all of the farmers in the >Mini= category) do not have freehold or other legal title to the land they farm. But in effect they have secure rights to occupy and farm that land, and their ownership is rarely challenged (John Feeley, personal communication, 1999). Sappi have the applicable tribal authority sign a statement acknowledging the grower=s right to use the land for tree planting and his entitlement to the proceeds of his enterprise (Rory Mack, personal communication). Three communal property associations are signing up with Mondi Forests in the Mzimkulu district of Southern KwaZulu-Natal at present, involving something like 50 ha of land.

Previously small plantings (less than 10 ha) did not require planting permits. Now all growers require permission and this is slowing the growth of the small grower schemes. For plots of less than 10 ha an abbreviated procedure applies, but for all larger plantings the requirements for a permit are fairly demanding. SAWGU have been able to negotiate a general allocation for certain midland catchments, based on an application that detailed the existing

plantings and the potential for expansion.

2.2.2.5 Public/Private ownership

According to the latest official survey figures (DWAF 1998a) companies own 768 348 ha whereas all other private owners (private individuals, partnerships and institutions) own the remaining 294 249 ha of private plantation.

Table 3: Plantation area by province and public or private ownership (DWAF 1996/97)

Province	Ownership (Hectares)		
	Private	**Public**	**Total**
Northern Province	37 483	23 104	60 587
Mpumalanga	477 477	148 548	626 025
North West Province	0	0	0
Gauteng	0	0	0
Free State	100	8	108
KZN	485 811	91 977	577 788
E. Cape	38 081	132 015	170 096
W. Cape	23 645	59 889	83 534
N. Cape	0	0	0
TOTAL RSA	1 062 597	455 541	1 518 138

Of the total planted area (1 518 138 ha), 30 per cent is in public ownership (see Table 3), the bulk being managed by the State owned company, Safcol (~286 000 ha), and the bulk of the remainder would be owned by DWAF (former homeland forests).

Table 4: Plantation area by species group and public or private ownership (DWAF 1996/97).

Species group	**Ownership (Hectares)**		**Total (Hectares)**
	Private	**Public**	
Softwood (pines)	432 992	364 618	797 610
Eucalyptus grandis	386 295	55 099	441 394
Other eucalypts	134 507	22 063	156 570
Wattle	104 000	8 029	112 029
Other	4 803	5 732	10535
Total	1 062 597	455 541	1 518 138

It is apparent from Table 4 that softwoods (pines) are relatively more publicly owned than other forestry species. 46 per cent of all softwood is publicly owned, compared to 12 per cent for eucalyptus grandis, 14 per cent for other eucalypts and a mere 7 per cent for wattle.

2.2.3 Distribution of forestry and afforestation

Forestry is primarily situated in the provinces of Mpumalanga and Kwazulu-Natal, comprising 41 percent and 38 percent of total plantation area in 1996/7 (Table 5). The remaining 20 percent are situated primarily in the Eastern Cape (11 percent), Western Cape (5.5 percent) and Northern Province (4 percent).

Table 5: Percentage change in Afforestation per province (DWAF 1996/7)

Province	**Total ha 95/96**	**New Afforestation[1] 96/97**	**Total 96/97**	**Percent of Total 96/97**	**% Change (95/6-96/7)**
Northern Province	60,006	581	60,587	3.99%	0.97%
Mpumulanga	623,479	2,546	626,025	41.24%	0.41%
North West Province	0	0	0	0.00%	-
Gauteng	0	0	0	0.00%	-
Free State	108	0	108	0.01%	0.00%
KwaZulu-Natal	572,109	5,679	577,788	38.06%	0.99%
Eastern Cape	168,583	1,513	170,096	11.20%	0.90%
Northern Cape	0	0	0	0.00%	-
Western Cape	82,664	870	83,534	5.50%	1.05%
Total R.S.A.	1,506,949	11,189	1,518,138	100.00%	0.74%

Source: DWAF (1998), FOA (1998) and own calculations

1 New afforestation excludes re-establishment and/or regeneration

Afforestation has been declining over the past 8 years, according to most recent DWAF and FOA estimates. In 1990/1, new afforestation (excluding re-establishment or regeneration) accounted for a 3.3 percent growth in total plantation area. By 1996/7 this growth had declined to 0.74 percent (Table 6). In 1996/7, the highest growth in new afforestation occurred in the Western Cape (1.05 %), followed by Kwazulu-Natal (0.99 %), Northern Province (0.97 %) and Eastern Cape (0.90 %) (See Table 5). The growth of forestry is primarily limited by biophysical considerations, since establishment is dependent on above average rainfall. Spatial distribution of forestry is therefore unlikely to change significantly in the foreseeable future. Furthermore, the declines in new afforestation also indicate that the total area under forestry plantations is also unlikely to increase significantly in the future. This implies that changes in environmental impacts over time are likely to be low. These impacts are discussed further in a subsequent section.

Table 6: New forestry by species and total plantation area

Year	New Afforestation (ha)[1]	Plantation area (ha)	Percentage change
1989/90	-	1,372,971	-
1990/91	45,423	1,418,394	3.31%
1991/92	28,241	1,446,635	1.99%
1992/93	16,578	1,463,213	1.15%
1993/94	18,649	1,481,862	1.27%
1994/95	13,140	1,495,002	0.89%
1995/96	11,947	1,506,949	0.80%
1996/97	11,189	1,518,138	0.74%

Source: DWAF (1998), FOA (1998) and own calculations

1 New afforestation excludes re-establishment and/or regeneration

2.3 Key Environmental Issues in Forestry

The primary environmental issues faced by the forest industry are listed below, each described briefly, and in order of perceived priority.

2.3.1 Streamflow reductions

Conversion of native vegetation to commercial timber plantations leads to reduced streamflow (water yields) from the planted catchments. For this reason the expansion of forestry has been regulated since 1972, first in terms of the Forest Act, and now as a >Streamflow reduction activity= in terms of the National Water Act of 1998. The competition for water between forestry, usually situated in the more humid upper portions of catchments, and other downstream water users continues to be a source of conflict and contention.

Streamflow reductions are directly proportional to the fraction of the catchment that is afforested, and are further positively related to the age of the trees, water availability, tree type and growth rate.

2.3.2 Habitat destruction and loss of bio-diversity

As the forest industry is built on man-made plantings of exotic timber species into native vegetation that is typically high in biodiversity, there is concern over the loss of specific habitats where the plantations are established. For the same reasons, there is concern over the conversion of large parts of some veld types of limited distribution nationally, to a monoculture of alien plants. Much of the commercial forestry is in the humid upland grasslands for which the only alternative economic use would have been rough grazing. Under grazing, even when not well managed the native ecosystem remains essentially intact. Forestry may also affect the vigour of riparian or aquatic habitats through reducing streamflows lower in the catchment.

Plantation forestry is concentrated mostly on grasslands, which counts as one of the seven biodiversity hotspots in South Africa - areas with an above average density of species, especially endemic species. Armstrong et al 1998 argued that commercial afforestation has a major impact on biodiversity in some regions in South Africa, basing their statement on a number of demonstrated empirical studies. A few conclusions are listed:

- It is observed that there are few small mammals in mature timber plantations, which affects numbers and diversity of predators (Armstrong & van Hensbergen 1995).
- Allan et al 1997 concluded that afforestation has a negative impact on grassland bird diversity.
- A lower count of plant species have been recorded in plantations when compared to natural grasslands (Lubke et al 1991).
- The number of fynbos species are reduced by the pine plantations in the Western Cape (Richardson et al 1996).
- In this same region it is recorded that natural vegetation surrounding plantations have three times as many bird species than young plantations, and ten times as many as old plantations (Armstrong 1993).

However, this is not a simple issue and there are strong counter arguments.

- Large parts of the largest forest estates are left unplanted, and these unplanted areas are often well managed for the conservation of the native ecosystem and its associated species. Such conservation opportunities seldom occur on other private land. Large forestry estates might therefore contribute significantly to the conservation of the natural ecosystem.
- Forestry is simply another crop and should not be singled out from other forms of dryland agriculture that displace native vegetation (e.g. maize, wheat, sugar). Forestry has less of an effect on bio-diversity than cultivated agriculture, where there are large imports chemicals. Forestry may well occur in different climatic zones than most agricultural crops, where less land had previously been cultivated, but the principle remains the same.
- In many cases forestry is one of several crop choices open to a private landowner, and trees are alternated with other crops (most commonly sugar) depending on the economics of the situation when the land due for re-planting.
- If a land-owner is to be denied the right to choose how the land is to be used for economic gain (for the purpose of maintaining bio-diversity) then some form of compensation ought be payable (by whoever benefits from the maintenance of biodiversity).

2.3.3 Carbon sequestration

Afforestation is often seen as a way to abate climate change, which in turn is caused by an increase of greenhouse gases (including carbon dioxide) in the atmosphere. Trees store carbon, the main element responsible for the enhanced greenhouse effect. The potential sale of carbon sequestered in South African plantations to countries which need to reduce their net carbon dioxide emissions have been recognised in a South African policy discussion document (DEA&T 1998). Although the value of carbon storage might be significant for plantation owners, some studies have suggested that there is a low potential for plantations being an effective instrument for lowering the total carbon balances in South Africa (Christie & Scholes 1995). This does not mean that the positive value accruing to forestry owners is negligible (Scholes, pers. comm.).

2.3.4 Effects on water quality

Forestry land generally is capable of yielding water of high quality, especially relative to intensive forms of agriculture. However, current harvesting operations and forest roads may be sources of increased sediment production from forestry operations unless carefully managed. Forestry may also have an indirect influence on water quality by reducing the volume of water in a stream or river. In this way, the concentrations of any effluents are automatically increased. Effectively therefore the receiving water resource has less capacity to absorb effluents if there is a substantial area of forestry higher up in the catchment. However, contamination is more directly associated with activities in other sectors than forestry; sedimentation from forestry land is typically ten times lower than that for agricultural land (see Scholes et al 1995:39).

2.3.5 Increased risk of wildfires and associated erosion

Forestry is practised in a landscape of fire-maintained sub-climax vegetation. The risk of fire during the dry seasons is always high. In plantations fuel loads are typically much higher than they would have been under the native cover, which is less productive and likely to be burned more frequently. As a consequence wildfires in plantations carry a large risk of causing severe heating of the soil, resulting in an increased risk of flood damage, soil erosion and sedimentation of downstream sites.

2.3.6 Aesthetics

Aesthetic effects of forestry are, being a matter of taste, perceived in many different ways. There is little evidence of the perceptions of the general public in South Africa of the aesthetic appeal of plantation forestry; few studies have been done, and aesthetics is seldom a priority issue. There is also little or no evidence that the large timber companies are pressurized by members of the public to modify their practices on the basis of visual considerations (with the exception of isolated cases). However, some of the more obviously undesirable visual aspects of plantation forestry can be managed, though rarely are at this time; for instance long straight lines along boundaries, large contiguous blocks of clearfelled plantation, a lack of visual variety, obscuring viewscapes, hiding or spreading unsightly slash piles. Attending to many of these issues would carry a cost, for example, removing certain areas from production.

2.4 Environmental Risk and Financial Performance

Poor environmental management can expose the forestry industry to significant financial risks, as the following international examples illustrate (see KPMG 1999):

< In May 1998, the forest company Louisiana-Pacific was fined US$37 million for a wide range of fraudulent and criminal practices, which included US$5 million for violations of the Clean Air Act - the largest penalty ever imposed. When the court case was announced, the company=s stock price fell by 20 per cent.

< MacMillan Bloedel is one of Canada=s largest forest product companies with 1997 sales of $4,5 billion. Recently, several large US and European companies cancelled or reduced their orders of forest products due to the company=s questionable environmental practices in British Columbia.

Therefore, accounting for environmental impacts on a policy level could have net benefits for the companies involved.

3. QUANTIFYING THE PHYSICAL IMPACTS OF FORESTRY ON THE ENVIRONMENT

3.1 Water-use

According to best national estimates of forestry=s water use based on experiments, hydrology models and GIS applications, the total amount of incremental water used by the forestry industry is approximately 1 417 million m; (study estimates) which amounts to approximately 7 per cent of total water use in South Africa (study estimates and DWAF, 1997).

The average water use of timber species differ considerably. The national average for all species is 934 m;/ha, with an average of 1 135 m;/ha for softwood species (pine), 708 m;/ha for eucalypt and 472 m;/ha for wattle (study estimates).

Since the ownership structure of plantation is not uniform across the different timber species, it can be expected that water use percentages (based on area) across different categories will change as well. Table 7 illustrates the percentage ownership of species across different categories and the impact on water use figures for these categories. It is apparent that large pine growers are responsible for half of the forestry industry=s water use (although owning 42 per cent of the total area), and when medium and small pine growers are added, this figure is almost 70 per cent. Mini growers are only responsible for 1 per cent of water use.

Categorising over species, pines are responsible for 69 per cent, eucalypt for 27 per cent and wattle for 4 per cent of total forestry water use in South Africa. In general, responsibility for water use is proportionally higher than area planted in the case of pine, but proportionally lower in the cases of eucalyptus and wattle species.

Table 7: Percentages of area and water use per ownership category and per species

	Large		**Medium & Small**		**Mini**		**Total**
	% of total area	**% of total water use**	**% of total area**	**% of total water use**	**% of total area**	**% of total water use**	**Water use**
Pine	42%	50%	15,1%	19,3%	0%	0%	69,3%
Eucalypt	29,3%	22,2%	4,8%	3,7%	1,2%	0,8%	26,7%
Wattle	2,4%	1,2%	4,9%	2,5%	0,4%	0,2%	3,9%
TOTAL	73,7%	73,4%	24,8%	25,5%	1,6%	1,0%	100%

3.2 Biodiversity Loss

Biodiversity is often thought of as a count of species, which is an important indicator, but inadequate in describing the importance of ecosystem services. A well-functioning ecosystem provides general life support (clean air, water quantity and quality) and acts as a sink to the by-products of economic activities (Winpenny 1991). A physical quantification of biodiversity as a complex system is a very premature scientific undertaking. However, the streams of goods and services of a healthy ecosystem can often be measured as thereby providing the basis of subsequent economic valuation. In this study no attempt will be made to quantify the economic loss of biodiversity services due to forestry activities.

3.3 Carbon Sequestration

Christie & Scholes (1995) calculated the uptake of carbon by new afforestation in South African pine and eucalyptus plantation forestry for 1990 and came to an amount of 2,54 Tg C/yr. Adding the carbon content of timber products, amounting to 1,15 Tg C/yr, the forestry industry stores a total of 3,69 Tg C/yr.

A back-of-the-envelope analysis for 1998 data follows the following steps[1]:

[1] These calculations can be refined in much more detail, taking account of tree growth

$ The mean carbon density (averaged over the rotation period) is about 30Mg C/ha (Scholes 1997). The net mean density, after subtracting 6Mg C/ha for natural grassland cover (Christie & Scholes 1995:233), is 24Mg C/ha. (Note that this is the mean carbon storage based on a static method, used in this study, which is appropriate when trees are harvested before or soon after they reach maturity. If the rate of afforestation varies greatly from year to year, the dynamic method is more appropriate (Christie & Scholes 1995:236)).

$ The area of plantation forestry in 1998 was an estimated 1 518 138 hectares.

$ The resulting net carbon density of all South African plantations is an estimated 36,4 Tg C.

$ The rotation length of South African trees range between 6 and 25 years (Christie & Scholes 1995:232); the implied average rotation value of 11,72 years based on 1990 calculations by Christie & Scholes (1995) is used in this study[2].

$ The resulting calculations show an average carbon uptake of 3,11 Tg C/yr. Adding an unchanged value of 1,15 Tg C/yr for timber products yields a total for 1998 of 4,26 Tg C/yr.

$ Hassan (1999), employing a dynamic method, calculated that the average C densities stored in industrial plantations in SA averaged 4,41 Tg C/yr over the period 1981/2 to 1995/6.

$ For further calculations only the carbon storage by plantations (3,11 Tg C/yr for 1998) are used, since it is not clear how carbon stored in timber products will be traded on a carbon market.

$ This is a crude figure as the carbon uptake vary considerably over the lifetime of plantations.

4. QUANTIFYING THE MONETARY IMPACTS OF FORESTRY ON THE ENVIRONMENT

4.1 Monetary Valuation of Water-Use

4.1.1 The opportunity cost of water

Forestry plantations are typically situated in the upper reaches of catchments in the high rainfall areas of, primarily, Northern Province, Mpumalanga KwaZulu-Natal, Western and Eastern province. Frequently, there many competing users downstream of forestry, for example irrigated agriculture, and domestic and industrial users.

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rotations and carbon densities at certain points in time.

2 1990 plantation forestry hectares were 1 241 000 (Scholes 1997). A net mean carbon density of 24Mg C/ha results in a total uptake of 29,78 Tg C. Divided by the calculated value of 2,54 Tg C/yr, the implied rotation period is an average of 11.72 years.

The opportunity cost approach is employed to estimate the economic cost of water. Opportunity costs may be seen as the value of water forgone to other economic users as a result of water abstraction by forestry. Whilst marginal cost pricing is a useful measure in competitive water markets, in the absence of these markets the opportunity cost principle may be regarded as an alternative proxy measure of the scarcity value of water (Hassan 1997). Several approaches for assessing the opportunity cost of water are now examined.

4.1.1.1. Value added approach

The value added (VAD) approach for attributing a value to water in a particular sector is based on the input-output framework. Total inputs to sector i, comprise intermediate inputs from other sectors, value added and imports. By deducting intermediate inputs, and imports from total supply, the residual remains, comprising wages and salaries to workers in sector i (Wi), rents paid to land and other natural resources used in industry i (Ni) interest and depreciation on capital (Ki) profits paid to owners of capital (Pi) and taxes paid to government (Ti).

Total value added (VAD) in industry i is therefore:

$$VAD_i = W_i + N_i + K_i + P_i + T_i$$

The value productivity of water is then obtained by dividing this measure by the quantity of water used in this sector.

4.1.1.2. Value added estimates

Gross agricultural value added is estimated to be R25057 million in 1996 (Conningarth Consultants 1999). Forestry Value added is estimated to be R3907 million, or 15.6 percent of total agriculture. Irrigated agriculture comprises 25.4 percent, and other agriculture (including fishing) comprises 59 percent. Table 8 summarises these estimates, and includes estimates of water use per sector (DWAF 1997b).

Table 8: Value added per m; water used by each demand sector

Demand sector	**Value Added[1] (1996 R million)**	**Total water use (Million m;/yr) [2]**	**VAD/m; (1996 R/m;)**
Forestry	3907	1 417	2.76
Irrigated agriculture	6373	10 927	0.58
Other agriculture	14 777	-	-

Domestic [3]	-	1520	-
Water	2143	-	-
Urban Industrial[3 4]	260 199	651	399.69
Mining	42 978	480	89.54
Industry	154 301	1118	138.02
Environmental use	-	3932	-
TOTAL	484 679	20045	24.18

[1] Conningarth Consultants (1999)

[2] DWAF (1997b), Paper 4 and this study (forestry water use).

3 As measured in municipal areas. Includes unaccounted for water. (Water consumed but not sold).

[4] Includes power generating sectors

It should be noted that the value added estimates for forestry are somewhat higher than previous estimates cited in the literature. For example, CSS estimated the contribution of forestry VAD to be 2.5 percent of total value in the early 1990s, and this has been the basis for determining contributions since then (Hassan 1999). Following this, Hassan (1999) developed independent estimates of forestry VAD, the most recent being R1,201 million for 1995/96, or 6.07 percent of total Agriculture. These were based on average production and harvesting cost information provided by the Forestry Economics Service (FES). Previously, Hassan (1998) used an estimate of R1411 million for forestry VAD in 1995, based on Net National Product (NNP). Current estimates are apparently based on revised Stats SA estimates (1993-1998) (Conningarth Consultants, Personal Communications). These estimates indicate that the forestry sector produces a higher value added per cubic metre of water consumed compared with irrigated agriculture. However, neither of these measures adequately reflect the important contribution that both these sectors make to the national economy. In total, South Africa generated R24.18 VAD in 1996 per m^3 of water used (Table 8).

4.1.1.3. Other opportunity cost approaches

While the abovementioned analysis provides a useful first cut top down analysis of the value of incremental water in South Africa, these are not true opportunity cost estimates of water use. Several authors (for example Young & Gray, 1985; Young, 1996) have shown that the VAD approach overstates the value productivity of water, since it imputes the productivity of all primary resources to the value of water. This does not imply that value added does not provide an appropriate basis for opportunity cost determination. Certain adjustments may be required to arrive at an appropriate measure. Either it needs to be assumed that the opportunity costs of other primary factors are zero, or it is necessary to deduct the non zero opportunity costs of other primary resources. This section considers ways in which the shortcomings of the value added approach have been overcome in the South African situation, and considers other measures for opportunity cost determination.

Early work by Hassan et al (1995), used the contribution to GGP as a proxy for value added, to assess the economic value of water in Mpumalanga. Mathematical programming techniques were used to derive the shadow price for water. More recently, a measure of Net Value Added (NVAD) has been used as an estimate of the opportunity cost of water (Hassan 1999). Net VAD is defined as the VAD foregone in irrigated agriculture due to water abstraction by forestry plantations. This is because the streamflow reductions by forestry plantations only result in an economic loss when forestry generates a lower VAD than other landuses, and vice versa.

A shortcoming of many previous studies (not necessarily those cited above) is that it is frequently assumed that all water downstream of forestry will find a productive economic use. Often, the assumption is that water will find a high value economic use, such as irrigated agriculture. In many instances, this is not the case. For instance, it has been estimated that 33% of water is lost due to spillage and evaporation (DWAF, 1997). Furthermore, forestry normally occurs in high rainfall catchments, so that the opportunity cost of water is frequently lower (because the run-off is higher and much of the water is unutilised. However, as demand for water increases these opportunity costs will increase. De Wit et al (1999) sought to overcome some of these problems by adjusting for loss of water due to evaporation and spillage, as well as accounting for the downstream spatial distribution of users (using Stats SA (1997) provincial figures as proxies for economic activities downstream of forestry). Table 9 summarises the range of opportunity costs available in the literature.

Table 9:Opportunity costs estimates. A comparison of previous studies.

	Hassan (1995)			**Hassan (1999)**	**De Wit et al (1999)**
	GGP/m^3 [1]	**GM/m^3 [2]**	**Model results[3]**		
Irrigation	0.30	0.65[4]	0.335[4]	0.372[7]	0.192
Domestic & Urban	-	-	-1.565 to -.003[5]	-	3.499
Mining & Industry	15.01	-	-	-	3.061
Dryland Agriculture	0.2	13.19, 1.22[6]	0.354, 0.002[6]	-	-
Environmental	0.01	0.003	-1.562 to 0.003	-	0.021
Surplus	0.22	0.19	-0.003 to -.565	-	-

1 Estimates of Gross Geographic product for Mpumalanga per unit water abstracted

2 Estimates of Gross margin at maturity per unit water abstracted, Nkomazi West, Mpumalanga.

3 Model outputs for Nkomazi West, Mpumalanga. Average across scenarios, except where otherwise indicated. There is some uncertainty as to the interpretation of these negative opportunity cost estimates.

4 Sugar cane only

5 Average across domestic urban and domestic rural users.

6 Dryland crops and livestock, respectively

[7] Net VAD estimates for 1995/1996

A third approach that has been employed in the literature is to derive estimates based on Net Terminal Value (NTV). See for example Hassan et al. (1998) in this regard. These determine the present worth at the end of a cycle or rotation of the stream of net benefits generated in future years. NTV estimates at the end of a rotation, divided by total water used over the entire cycle provide economic measures of water use efficiency. These measures have the advantage of considering the costs and benefits over the entire production cycle of the crop. Tables 10 summarises the Net Terminal value estimates derived in this way. The results indicate that (1) there is a wide range in NTVs across species (a minimum value R-0.052 per m^3 for Pine rotations, to a maximum value of R2.99 per m^3 for Eucalypt rotations). Furthermore, (2) Eucalypt rotations yield higher NTVs than Pine rotations. (3) Higher productivity classes yield higher NTVs than lower productivity classes. Finally (4), pulp rotations in general give higher NTVs than sawlog classes.

The high range of values indicates the variations in opportunity cost estimates that are likely to arise as a result of different methods adopted for estimation. The question remains which of these are 'viable' for forestry and which are not. In terms of viability, the issue is not what should be implemented, but rather what are the thresholds of these estimates. In the following section an attempt is made to place an 'upper limit' on opportunity cost estimates, defined in terms of the maximum cost which may be imposed on the forestry sector for it to remain economically viable.

Table 10: Net terminal values for forestry species (1994 data)

	Net Terminal Value (Rand per m^3)			
	Average Practice	**Category**	**Best Practice**	**Category**
Pine Rotations				
Lowest	0.165	Sawlog	-0.052	Class 1 Sawlog
Highest	0.271	Pulpwood	0.686	Class 3 Pulp
Eucalypt Rotations				
Lowest	0.817	Pulpwood	1.544	Class 1 Sawlog
Highest	2.990	Sawlog	2.198	Class 3 Pulp

Source: Hassan et al (1998)

1 Negative values denote economic loss

2 Class 1 denotes low productivity. Class 3 denotes high productivity

4.1.2 Net-back analysis

4.1.2.1 Method and approach

A net back analysis (see for example Bate and Dubourg, 1997) is conducted to determine whether a particular activity (for example forestry) would remain profitable if the full opportunity cost of water is charged. In addition, the effects of a price allocation is examined. This technique has previously been employed in the Crocodile River Catchment to assess the economic viability of 6 crops (Bate et al 1998; Tren 1998). The approach has previously been used to compare the economic price of water with the maximum willingness to pay (WTP) for water. The latter is calculated by estimating total revenue, and then deducting non-water input costs and subsidies. Current water charges, where applicable, are then added back. The difference between the maximum WTP and the full economic cost of water provides an indication of the economic viability of a particular sector to full cost pricing. If economic charges exceed maximum WTP, then an industry is not economically viable. In apply this approach with the forestry sector, the issue is not whether the industry will be viable under full cost pricing, but rather to establish an upper limit or threshold for opportunity cost estimates.

Total revenues per forestry species are calculated from the standing value of timber per species (pine, eucalypt, wattle). Non water variable input costs, and allowances for >sunk costs= and overheads not related directly to the production activity are deducted, to obtain a net margin per hectare. These estimates were obtained from the Forestry Economic Services report (FES 1997). Since subsidies and water charges are currently zero for the forestry sector, these estimates form the basis for maximum WTP per species for forestry. The following section summarises the findings from this approach.

4.1.2.2 Results of analysis

In order to arrive at upper bound opportunity cost estimates, maximum WTP derived by means of the techniques described in the previous section is divided by water use estimates per species derived by forest hydrology models. Water use estimates per species per annum were then divided by total hectares planted under each species to obtain estimates of water use per hectare. The results are summarised in Table 11.

Table 11: Opportunity cost (upper bound) estimates at which all economic rents are dissipated, per forestry species

Species	**Water use (m^3/ha)** [1]	**Max WTP (R/ha)** [2]	**Upper bound estimate (R/m^3)** [3 4]
Pine	1199.51	362.33	0.302
Eucalypt	748.03	712.71	0.953
Wattle	499.14	526.11	1.054
Total [5]	986.46	890.37	0.903

1 Obtained from forestry hydrology models (this study)

2 Based on FES (1997)

3 Max WTP (R/ha) divided by Water use (m3/ha)

4 The upper bound opportunity cost estimate (R/m3) indicates the maximum water price that can be imposed per species, before production that species becomes economically unviable. Opportunity costs may exceed this value, but the forestry sector will no longer afford to operate.

5 Total figures (water use and maximum willingness to pay) based on FES (1997).

The upper bound opportunity cost estimate gives an indication of the threshold economic viability of a particular species under full (economic) cost pricing. It indicates the price of water at which economic rents are dissipated for a particular species. Therefore, if the economic price per unit (R/m3) of water exceeds this threshold value, the species in question is no longer economically viable. Table 11 indicates that wattle has the highest upper bound opportunity cost estimate, and is the most resilient to water price increases. This is followed by eucalypt and finally pine. This means that pine plantations are most likely to be non viable under full economic pricing.

Comparing these results with those from other studies (Tables 9 and 10) we see that virtually all species are economically viable under the opportunity cost estimates of irrigated agriculture. However, opportunity cost estimates for domestic and urban exceed the maximum opportunity cost estimates derived under the net back approach, so forestry species would not be economically viable under these opportunity costs. Similar conclusions may be drawn for opportunity cost estimates under the industrial and mining sectors.

4.2 Monetary Valuation of Carbon Sequestration

What is the economic value of carbon sequestration? Since climate change is a global problem and countries have opted to address the problem in a global way, the value for carbon is to be set on international markets (in US$). Following the Kyoto Protocol and Buenos Aires COP4 meetings, negotiations are continuing around the formalisation of so-called Kyoto mechanisms (previously called flexibility mechanisms). These mechanisms all include some form of emissions entitlements through bi/multilateral agreements (Joint Implementation (JI) and the Clean Development Mechanisms (CDM)) or markets in carbon rights (International Emissions Trading (IET)). At this stage agreements on credits for sequestration are not awarded through large-scale international markets, but through bi-lateral and multilateral agreements such as activities implemented jointly (AIJ) schemes.

Existing estimates of the economic costs of CO_2 emissions are all tentative and inexact. Various researchers have come up with different values, based on different assumptions and methodologies. Table 12 presents an overview of the economic costs of CO_2 emissions in different decades according to different researchers. The figures highlighted are used the further scenario calculations of forestry carbon sequestration benefits.

Table 12: Economic costs of CO_2 emissions in different decades (US$/t C)

	1991 - 2000	**2001 - 2010**	**2011 - 2020**	**2021 -2030**
Nordhaus (1993)	**5,3**	6,8	8,6	10
Peck & Teisberg (1993)	10 -12	12- 14	14 - 18	18 - 22
Anderson & Williams (1993)	25 - 50	50 - 120	**120**	120
Fankhauser (1993)	**20,3**	22,8	25,3	27,8

Source: World Bank 1994

Taking the lowest and highest cost estimates and impute them for the amount of carbon sequestrated by forests in South Africa will give a feel for its potential value. Some estimates are presented in Table 12. These values represent the economic value of the total stock of carbon stored by the forestry industry.

Table 13. Economic value of forestry carbon sequestration

	Plantation carbon uptake	**Potential economic value of forestry carbon uptake[1]**
Low	3,11 Tg C/yr	R 98,89 million[2] (R149 million)
Medium	3,11 Tg C/yr	R 378,8 million[3] (R445 million)
High	3,11 Tg C/yr	R 2 239,2 million[4] (R1048 million)

1. Assume exchange rate of R6.00/1US$.
2. R31,80/t C * 3 110 000 t C/yr.
3. R121,80/t C * 3 110 000 t C/yr.
4. R720/t C * 3 110 000 t C/yr.
5. Economic values based on Paper 5 estimates of R48 (low), R143 (medium) and R337 (high) per ton carbon, are given in parenthesis

It must be highlighted that these are potential economic values since no market or agreements on forestry carbon sequestration exist at this stage. It must also be noted that the dynamic method might give different values, because the area of forestry planted in South Africa is not constant and trees are harvested in relatively short times when compared to indigenous forests. This is a serious limitation of the presented analysis and therefore the potential economic value of forestry carbon uptake should only be interpreted as an order of magnitude.

These costs can give an indication of the willingness-to-pay for carbon sequestration, but does not necessarily have to be these values. How the market will be segmented is not clear yet. For instance, carbon stored in timber products might never be traded on a carbon market. It is however, a potential external benefit of the forestry industry, assuming that there are well-defined emissions entitlements and an existing market or agreements in/regarding carbon sequestration rights.

5. THE PRICE ELASTICITY OF DEMAND IN THE FORESTRY SECTOR

Price elasticity estimates indicate the percentage change in the quantity of water used as a proportion of the percentage change in the price of water. The availability of literature estimates for the price elasticities of water, particularly in the South African context, are scarce. Even internationally, we are unaware of any studies considering the demand elasticity of water in forestry. If the range of price elasticity estimates for water are considered, urban/household estimates are most frequent, followed by irrigated agriculture. Table 13 gives an indication of the typical ranges of values currently found in the literature.

In general the international literature suggests that price elasticities for water are fairly inelastic (less than 0,5), with irrigated agriculture having the lowest elasticities (Department of Water Resources 1998). Furthermore, as expected, long term elasticities are higher than short term elasticities in the majority of cases (Department of Water Resources, 1998). This allows for the possibility of substitution towards more efficient technologies and practices. Although possibility of increases efficiencies of water use are more remote in forestry, substitution towards species which are more efficient water users are a possibility. The extent to which this is possible in practice is subject to financial, biophysical and social constraints. Improved estimates of water price elasticities of forestry water use in SA will need to be derived after further refinement of the available data.

Table 14: A comparison of national and international price elasticities for residential, urban, irrigation agriculture and total water use

Sector	**Price elasticity**
Primary Production[1]	-0,4
Wood and Wood products[2]	-1,0
Pulp, Paper and Paper products[3]	-0,5
Irrigated Agriculture[4]	-0,25
Water[5]	-0,6

1 Short run own price elasticity for primary production in SA (Liebenberg and Groenewald 1997, cited in Hassan 1997)

2 Brooks et al (1995). Average (significant) short run own price demand elasticities for low income countries.

3 Buongiorno (1978). Average (significant) short run own price demand elasticities for low income countries.

4 International average estimate of price elasticity of demand for water. (Department of Water Resources 1998)

5 Price elasticity of demand for water in South Africa (Dockel 1973, cited in Hassan 1998).

6. THE IMPACTS OF A CHANGE IN WATER PRICES ON THE FORESTRY SECTOR AND THE ECONOMY

6.1 Introduction

The charging of forestry water use is likely to have various effects. In the short term it is unlikely that total water use will change. This is because plantations typically have long rotations, although the length varies per species. Pines on average have rotations of 30 years, eucalypt approximately 10 years and wattle also around 10 years, although rotation lengths do vary within species, depending on the purpose for growing (eg. pulpwood or sawlog). Secondly, on the basis of historical data it is unlikely that significant new afforestation will occur, either spatially or temporally (see section 2.2.3). There are biophysical, political and economic constraints associated with this. It is likely, however, that demand for sales from plantations will be affected through the price mechanism. Higher inputs are expected to result in higher product prices, through changes in marginal costs.

The modelling approach which is adopted to assess the impact of changes in the price of water, fall into the category of economywide general equilibrium models. These models follow the Walrasian market clearing assumption, in that demand will adjust (following a shock) until a new equilibrium is established, either at a higher or lower level of output. These models have the advantage of assessing not only the likely impacts on the forestry sector following changes in the price of water for forestry, but also the knock-on effects of this price change on other sectors. The approach has the disadvantage of being largely comparative static in nature, and therefore being unable to adequately assess marginal increments in prices over time.

6.2 Background to economywide models and previous research

In order to determine the economywide impact of specific sectoral policies, a variety of instruments are available. Two will be highlighted and discussed at this juncture: the Social Accounting Matrix (SAM) and IO frameworks. Whilst the SAM approach is a considerably broader approach, endogenising household transfers, income to factors of production (value added) and other transfers, it has the disadvantage of being exceedingly data intensive and time consuming to construct. Further information on the theoretical construct of SAMs may found in, for example, Sadoulet and de Janvry (1995), and Mc Donald et al (1997). Several SAMs have already been developed and applied in various contexts within South Africa, the most well known include CSS (1988,1993) and DBSA (1997). Applications in the agriculture sector include Eckert et al (1997a, 1997b) and Hassan (1998).

The purpose of this component of the study is to provide an up to date understanding of the possible impacts of water price changes, primarily focussing on the forestry sector. Therefore an input output approach was deemed sufficient for this purpose. A variety of studies have already employed the IO framework for modelling policy effects in South Africa. Van Seventer et al (1992) for example, employed an IO table of agribusiness in South Africa for 1985, which identified 61 production activities. The study focussed on a key activity analysis of the South African economy, and did not conduct any policy simulations. Van Zyl & Vink (1988) used CSS data to examine the effect of an increase in agricultural production on mainly agriculture related sectors.

Very few studies have modelled the policy effects of water price changes. Hassan (1997) used input output data based on the DBSA (1997) 1995 SAM to model the effects of trade liberalisation and water pricing policy. The water pricing study modelled a 40 percent increase in water rates for irrigated agriculture. This resulted in a 2.6 percent decrease in total output where no reallocation of land occurred, and a 0.9 percent decline in total output where 60 percent of land was reallocated to other agricultural activities.

The water pricing effects of forestry, however, cannot be modelled in this way since forestry has historically not been charged for water. Hassan (1998), employing a SAM approach also based on the DBSA 1995 SAM, overcame this problem by creating an additional exogenous account to incorporate water subsidies by the water sector to various intermediate demand sectors. Policy simulations modelling the phasing out of these subsidies have the same affect as water price increases. Various policy scenarios were explored, investigating different assumptions on the phasing out of water subsidies on different sectors. None of these scenarios focussed exclusively on the forestry sector. However, the results show that overall economywide effects are small. Where substitution between supply sectors is allowed, the change in output is positive (between 0.88 and 0.98 percent). Where substitution is not allowed, output decreases by between 0.03 and 0.07 percent.

6.3 Methodology

In the current approach, an input output framework is employed to model inter-sectoral effects. Although it is recognised that a SAM approach is preferable, the reasons for the use of this approach are essentially as follows: Firstly, it has been argued that SAM is more appropriate when final demand effects are strong (Hassan, pers comm). Whether this is indeed the case for forestry is not conclusive. Secondly, the study employs the most up to date information available in order to answer the research question, which is to assess impacts on the forestry sector. The framework can be expanded to address other issues when required, such as the effect of policy on redistribution, employment or government budget. The input output table of Conningarth Consultants (1999), based on 1996 sectoral information, was used as basis. This was the most recent and comprehensive information on intersectoral relationships and transactions available to the authors at the time of compilation. The original IO table contained 116 productive, distributive and services sectors. Sectors were aggregated in order to represent in a format useful to the study. The final IO table used for the analysis contained 7 sub-sectors and one final demand sector. Based on this IO table, it was possible to conduct the necessary water price simulations.

6.4 Water Price Simulations

Because IO tables do not explicitly account for prices in their structure, an intermediate step is required to translate water price changes into demand responses. It is hypothesised in the current approach that an increase in water input costs to forestry will reduce profitability in the short run. Prices in the forestry sector will therefore increase in order to compensate for losses of productivity. The higher prices, in turn will reduce final demand for forestry products.

In terms of the water sector, it is hypothesised that the pricing of water to the forestry sector will result in an increase in revenue, and that this will result in an increase in profits to the water sector. Since the quantity of water demanded is likely to be unchanged in the short term, the higher water price will result in increased returns to final demand. The model therefore simulates two effects: the first effect is the price effect, and the second effect is the output effect following changes in demand.

The following steps are therefore required to assess the economywide impacts of a water price policy for forestry:

- Reduction in profits as a result of the pricing of water at different opportunity cost levels

- The associated changes in sector prices required to offset declines in the profitability of non water sector
- The increase in overall water prices in the water sector following opportunity cost pricing in the forestry sector
- The changes in final demand, primarily in the forestry and water sectors
- The associated impacts on total sector output.

The following sections briefly describe the assumptions and approach adopted to address each of these steps.

6.4.1. Opportunity cost estimates

The model is run over a very wide range of opportunity cost estimates. This is to ensure that all possible outcomes are included. The following scenarios are therefore investigated:

SCENARIO 1 evaluates the effects of introducing a water pricing tariff base on most recently available information from DWAF. It is still not clear what the final pricing structure will be. Current estimates based on the unit costs for water resource management charges in forestry imply a total cost of water use to forestry of just over R1 million (Current 1999 estimates discounted back to 1996 values using a discount rate of 8 percent). Total water costs for the sector are estimated at marginally over R1 million. This constitutes a very low increase in costs for forestry, which had total profits of R2.6 billion in 1996 (IO table). The total increase in forestry prices is expected to be very low as a result.

SCENARIO 2 considers the imposition of a water price based on the maximum willingness to pay following calculations based on FES (1997). This was estimated to be R0.903 per m^3 for forestry as a whole (Table 9). Multiplying this by total water used implies a total value lost to forestry of R1.3 billion, or a 50 percent reduction in profits.

SCENARIO 3 determines an upper bound opportunity cost estimate, based on the value estimate that would reduce industry profits to zero. This implies an opportunity cost of water of R1.81 per m^3. The loss in profits associated with this opportunity cost estimate is R2.6 billion at 1996 values.

In all cases, income received from higher prices accrues to the water sector, resulting in higher profits. It is assumed that, over the short term, forestry will not adjust its demand for water.

6.4.2 Price effects

Once the impacts on profitability following the implementation of water pricing to forestry have been determined, the next step is to model the effect on sectoral prices. The price responsiveness of the various sectors to changes in profitability is determined by the following equation:

$$P' = (V' + M')(I - A)^{-1}$$

where P' (1xn) is the price vector, V' (1xn) is the vector of value added, M' (1xn) is the vector of intermediate imports and the latter component is the standard Leontief inverse (n x n) described below. The exogenous variables are V' and M', and the endogenous variable is the vector of prices P' which, it can be shown, is the 'unit vector' under the base case.

6.4.3. Economywide output effects

Changes in sectoral prices need to be related to changes in final demand. This is undertaken using sector specific elasticities. Note that we are interested in own price elasticities for demand in this instance, and not water price elasticities (for the non water sectors). The relevant elasticities for the forestry and water sectors are summarised in Table 14. For the purposes of this study it is assumed that non-forestry and water related sectors have an elasticity of zero. The assumption is therefore that final demand sectors for these products do not respond to changes in prices over the short term. Once the change in the final demand for the various sectors is known, the change in output may be modelled. This is undertaken based on the standard Leontief inverse, which may be represented in the following way:

$$\Delta y = (I - A)^{-1} \Delta d$$

where I is the identity matrix (n x n), A is the matrix of inter-industry coefficients (n x n). ? d (nx1) represents a vector of demand shocks, and ? y (nx1) is a vector of the associated sectoral impacts on output.

6.5 Discussion of Results

The price increases required to offset these declines are summarised in Table 15. Under Scenario 1, the overall price increases are very low (less than 1 percent). Under Scenario 2, the price of forestry increases by 26 percent, while the change in other non-water sectors is low (less than 1 percent). Under Scenario 3, the price increase required to offset declines in profitability is 73 percent. Again, all non water sector price increases are less than 1 percent. The overall water price increases associated with the water pricing policy for forestry range from 0.3 percent (Scenario 1) to 64 percent (Scenario 3). (Table 15).

Table 15. Model Output Results for the different policy simulations

	SCENARIO 1		SCENARIO 2		SCENARIO 3	
SECTOR	Price %change	Output %change	Price %change	Output %change	Price %change	Output %change
Irrigated Agriculture	0.000	0.000	0.192	0.009	0.388	0.015
Forestry	0.017	-0.003	26.448	-4.613	73.038	-12.754
Other Agriculture	0.000	0.000	-0.017	-0.008	-0.033	-0.041
Mining	0.000	0.000	-0.130	0.011	-0.263	0.020
Industrial	0.000	0.000	0.094	0.024	0.190	0.038
Water	0.025	0.009	31.918	11.415	64.413	23.021
Transport, Trade & Service	0.000	0.000	-0.119	0.016	-0.240	0.022
TOTAL		0.000		0.051		0.072

[1] Note this modelling exercise only considers the effects of pricing water in the forestry sector, with redistribution of income to the water sector.

The change in demand for forestry products as a result of changes in price is determined by employing an elasticity of demand of –0.4 (Table 14). The associated changes in output under the 3 scenarios vary quite significantly, as would be expected given the range of opportunity costs employed. As evidenced by the previous table, total changes in sector output under policy Scenario 1 were low, the highest change being in the water sector, at about 0,01 percent. Under Scenario 2, sector output for forestry fell by 4.6 percent and increased in the water sector by 11.4 percent. Overall, output increased by 0.05 percent. Under Scenario 3, output fell by 12.8 percent following declines in demand. Output in the water sector increased by 23 percent, following the higher value earned from the final demand sector. Overall, output increases by 0.07 percent following these demand effects.

6.6 Linkages with the Pulp and Paper Sector

The majority of sales from plantations are to local processors (Godsmark, pers. comm.) so a significant proportion of timber price increases will be passed on to the processing sector. The inelastic demand suggests that the domestic processing sectors will bear the brunt of the price increases. The extent to which this cost increase impacts on the product price is dependent on the export orientation of the sub-sectors in question. While products competing on the international markets need to remain competitive in price, the exchange rate mechanism may also play an important role.

A significant proportion of production in the pulp and paper sectors are destined for the local market. In 1997, 24 percent of paper and board production (by quantity) was exported, and 35 percent of pulp (PPI 1998). This potentially has the following consequences: higher domestic prices for pulp and paper products, reduced competitiveness of South African exports, reduced domestic production and increased imports.

There are many other factors influencing future pulp and paper industry, such as expected world and domestic consumption growth rates, economic growth, environmental groups and legislation (Poyry 1999). Political and economic stability, influencing the internal and external value of the rand and government spending are also likely factors. Many other demand and supply and institutional effects are likely to influence the industry, such as the privatisation of SAFCOL, demand for paper products (such as academic books), capacity availability, labour disputes, printer quality and investment expenditure by industry. Given the relatively small price increases expected as a result of water pricing in the forestry sector, and the average expected growth in paper and board consumption, estimated at approximately 2,8 percent per annum for 1995-2010 (Poyry 1999), other (non water) effects are likely to be more dominant.

7. MITIGATION TECHNOLOGIES AND POLICY INSTRUMENTS FOR ADDRESSING ENVIRONMENTAL IMPACTS OF FORESTRY WITH SPECIFIC REFERENCE TO WATER USE

7.1 Background

It was demonstrated that the opportunity cost for water used by forestry can range quite significantly, depending in the sector with which it is compared. In most cases if the full opportunity cost is charged, with the notable exception of opportunity costs in the domestic & urban sector, forestry will still be viable. It was also illustrated that water use charges will lead to economic losses not only in the forestry sector, but also in sectors with linkages to the forestry sector. In the case of water use charging, it would be in the interest of forestry to mitigate water uses in the most cost-efficient way possible. The potential benefits from carbon sequestration are also in the order of tens of millions of rands. It would therefore also be in the interest of the forestry sector to capitalise on these potential benefits. The mitigation of biodiversity and habitat loss, although unquantified in this study, is often bound and guided by political set standards and agreements, which will also be in the interest of the forestry sector to comply with.

7.2 The Need for a Forestry Policy

The negative environmental impacts of forestry, other than water use, have been spelled out earlier in this study (see also Armstrong et al 1998; Scholes et al 1995). In a recent paper Foy & Willis (1998) made an argument for a specific policy for the forestry sector based on two arguments:

$ Market failure in the forestry sector
$ Specific characteristics in the forestry sector warranting a targeted forestry policy

Market failure in the forestry sector relates to the non-pricing of water use and the loss of biodiversity value. The inclusion of carbon sequestration as a potential >forestry product=, is an issue of institutional limitations at this stage, rather than one of market failure. In the case of market failure targeted policy instruments can be employed to ensure that the trade-offs between multiple objectives are well defined and informed (Foy & Willis 1998:36).

It is often stated that the forestry sector warrants special attention mainly because of the conflicting needs and priorities of diverse societies and because it helps to ensure that the sector continuous to receive political support (Foy & Willis 1998). In fact, every sector with policy, institutional and/or market failures would need a targeted sectoral policy. Since the true costs of environmental impacts have not been taken into account in any sector linked with natural and environmental resources in South Africa, complementary policy instruments for each of them should be considered as a research focus.

7.2 Policy Options

Although macroeconomic policies, as such have an important overall positive impact on environment, they should be supported by other more targeted environmentally and institutional policies to smooth the transition phase towards greater macroeconomic stability. Market & policy failures and institutional constraints may cause environmental harm unless addressed through specific additional measures that complement the macroeconomic strategy (see Munasinghe 1996:21, Munasinghe & Cruz 1995). A water pricing strategy is an example of such a complementary policy.

In general, targeted policy instruments could be classified in economic and non-economic policy instruments (OECD 1994). We can distinguish between:

$ Non-market based (technological, institutional or managerial) approaches available to influence environmental externalities, notably water use, by the forestry sector. Examples are standard setting through regulations and laws, which permit or limit certain actions.
$ Market based instruments, such as water pricing (water tax or tradeable water rights), available to influence water use by the forestry sector.

Table 16 displays the range of policy options to deal with natural resource and environmental management issues. The first column indicates market-based instruments, the second a hybrid between market and non-market based instruments, and the third and fourth column non-market based instruments.

Table 16: Policy matrix

Using markets	Creating markets	Environmental regulation	Engaging the public
i) Environmental taxes on inputs or products ii) Performance bonds/ deposit-refund iii) Targeted subsidies	i) Property rights and decentralisation ii) Tradeable permits and rights iii) Offset systems	i) Standards ii) Bans iii) Quotas	i) Information disclosure ii) Public participation

Source: World Bank (1997)

This matrix illustrates that mitigative policies for the impacts of macroeconomic policies on the environment need not to be sought in an adjustment of macroeconomic policies alone. A selection of targeted policy instruments can be made based on different policy, market and institutional settings.

7.3 Criteria for the Selection of Policy Options

Which policy instrument is the most appropriate? Although the policy matrix includes many different instruments it does not discuss when policy instruments meet the criteria of efficiency, ecological sustainability and long-term human objectives. The Policy Selection Matrix (Table 17) gives some guidance by linking experience to the theories underlying the various instruments.

Table 17: Example of simple policy selection matrix

<table>
<tr><th rowspan="2"></th><th colspan="7">POLICY INSTRUMENTS</th></tr>
<tr><th>Taxes</th><th>Charges</th><th>Dep refund</th><th>Subsidy</th><th>Tradeable permits</th><th>Command and control</th><th>Information</th></tr>
<tr><td>Static cost efficiency</td><td colspan="5">+++
With large differences in abatement costs there may be considerable cost savings in all market-based instruments.</td><td>-
Can be costly</td><td>0</td></tr>
<tr><td>Goal fulfilment</td><td colspan="4">---
All these instruments, which rely on correct estimates of public responsiveness, imply a risk when exact goal fulfilment is essential. Particularly if environmental cost curves are very steep. Risk of too low taxes may be unacceptable.</td><td>++
maybe best since aggregate environmental damage can be controlled</td><td>+
Good control of individual sources</td><td></td></tr>
<tr><td>Dynamic efficiency</td><td colspan="3">++
Market based instruments may have the greatest potential for cost saving and efficiency</td><td colspan="2">+
For subsidies and tradable permits it depends on the details of each individual scheme</td><td>--
CAC does not easily adapt</td><td></td></tr>
<tr><td>Complex environ-mental criteria</td><td colspan="5">--
When the environmental conditions to be monitored are sufficiently complex it is hard to see how tax or legislation can be made sufficiently detailed.</td><td colspan="2">++
In these cases individual permitting (or info disclosure) may be superior</td></tr>
</table>

Vested interests & concern for distri-butional issues	-- least popular	-? Charges can be refunded to make policy palatable	+ can be designed to be more cost neutral	++ ultimate policy if no exploiter can be found	+ can be designed to be more cost neutral	++ no cost in excess of abatement	+.+
difficulty in monitoring	-- hard to use		++ self-monitoring	+? Can be useful	-- hard to use	+ first necessary step	
large number of agents	+ these general policies are favourable for reasons of administrative efficiency - not reasonable to apply				best with intermediate number	+ best	applicable irrespective of numbers?
rent seeking				- encourages rent seeking	- may be used as barrier to entry	- individual negotiation has its risks	

Source: Sterner 1998.

These policy instruments either strengthen property rights regimes (creating markets, regulations and engagement of the public) or built on these stronger regimes (using markets). Regulations and/or public engagement might be necessary when complex environmental conditions occur and when distributional issues need to be addressed. As evident from Table 17 the selection of policy instruments involves some hard choices. Market -based instruments are more efficient, but only if they are simply designed and implementable. This simplicity do not meet certain criteria around complexity in the environmental system and is under pressure when distributional criteria need to be accounted for and monitoring is required. This study would not attempt to select policy instruments for the forestry sector, which is a far broader study, but only places the economic efficiency criterion into a broader perspective.

Before returning to the question what policy options are deemed appropriate for the forestry sector in South Africa, some international experience with forestry policy is presented.

7.4 International experience and lessons

Based on a KPMG (1999) study of international policy developments in the forestry sector, the following conclusions and lessons learned can be drawn:

< There are many ongoing initiatives at an international, intergovernmental, national and non-governmental level, which are important for the forestry sector. Hence, South Africa does not need to >reinvent the wheel=. These initiatives are described in Appendix B.

< Not much information is available on the water-related dimensions of international forestry policy. South

Africa=s position, with the possibility of a few other countries with comparable water stress and forest sectors, is relatively unique. However, more research is required to evaluate these early findings.

< The most progress and consensus has been reached in the area of identifying Criteria and Indicators of Sustainable Forest Management. This would seem the place to start for South Africa. An overview of developments in this field is included in Appendix B.

< The most relevant initiative for South African conditions is probably the so-called >UNEP/FAO Sub-Saharan Africa Dry Zone process=. Building a national effort based on this regional effort makes sense. More detailed research need to be conducted into the applicability of the Dry-Zone Africa Process for South Africa.

< An area of current and future focus will be around finalising national and regional policy approaches. It is recommended that a multi-stakeholder process of creating national or regional (Southern African) standards for the management of sustainable forests be initiated.

< A future trend will be to find appropriate policy instruments to deal with forestry=s role in the emerging Climate Change Convention recommendations (eg how the Kyoto mechanisms can be used to the advantage of forestry through credits linked to carbon sequestration). For an overview of potential future forestry policy see Appendix C.

7.5 Policy Instruments Currently Used and Proposed

7.5.1 Background

South Africa=s National Forestry Action Programme (SANFAP) published in 1997 provides the background for the development of a new forestry policy. For commercial forestry, according to this publication, the general opinion supports the need to identify a set of minimum standards that should be enforced by statutory regulation (DWAF 1997a:71). It is stated that the new Forestry Act should create enabling legislation to promote and support recognition of appropriate criteria and indicators of sustainability, and for the enforcement of agreed minimum standards (DWAF 1997a:73). These proposed instruments for sustainable forestry management are in line with international forestry policy (see Appendix B), but do not leave enough room for the potential application of market-based economic policy instruments.

For community forestry, the general problems are related to the lack of well-defined property rights (lack of secure access to resources and discriminatory past policies (DWAF 1997a:35)) and lack of enabling environment to access markets (limited income opportunities, consistent under-valuation of community forestry resources (DWAF 1997a:35)). Policy instruments are therefore targeted at institutional arrangements to ensure well-defined property rights and ensuring market access.

7.5.2 Policy for water-use: Riparian reserves

The main environmental safeguard in South African forestry is an unplanted buffer zone along rivers, wetlands and other water bodies. A riparian reserve is universally accepted as a fundamental >best management practice= in world forestry, for reasons of buffering streams from water quality impacts and water temperature increases. In South Africa this practice has its roots in attempting to ameliorate the streamflow reduction impacts of plantations, but the other benefits also apply. The water savings associated with this practice have also been demonstrated experimentally (Wicht 1941; Rycroft 1955; Banks 1961; Scott in press). Clearing of plantation in the riparian zone of a catchment will lead to increases in streamflow out of proportion to the relative area cleared. As a rough rule of thumb it can be estimated that not planting a riparian zone that comprises 10 per cent of the area of a catchment will result in a 20 per cent saving in streamflow.

In terms of Forest Act regulations the unplanted strip was initially set as a minimum of 20 m either side of a stream, but this limit was later specified (usually at 30 m) under conditions set in the planting permit. The >Guidelines for environmental conservation management in commercial forests in South Africa= (GEC), issued by the Forestry Industry Environmental Committee (1995) and endorsed by the large forestry companies in South Africa, stipulates that >Commercial trees should not be planted closer than 30 m from a permanent stream, or spring, or 50 m from a wetland.= These guidelines are used throughout the industry now, though many earlier plantings were much closer to streams, and such plantings are only likely to be removed at the end of the rotation.

7.5.3 Policy for ameliorating the effects on biodiversity and habitat loss

There are several opportunities to ameliorate the negative impacts of afforestation on biodiversity and habitats.

The unplanted riparian reserves provide opportunities for wildlife and biodiversity corridors to be established through large blocks of plantation, linking other areas of native vegetarians; and the riparian reserve is frequently the major block of natural vegetation in a plantation.

As a general rule a planting permit would not have been given for more than 75 per cent of a single property. Where planting conditions dictate this upper limit, the unplanted portion of the estate provides an opportunity for managing for ecosystem conservation. Elsewhere, the unplanted portions of estates were sometimes sold off to neighbours who could use the land for an alternative productive use (eg grazing or cultivation for sugar). In other cases, second permits were granted for the remaining unplanted area once the initial allocation had been planted.

The extent to which unplanted areas within a forest estate are used for biodiversity benefits is dependent on the objectives and quality of management. While unplanted areas may contribute positively to conservation of native species, they might also be farmed for some other use where suitable, or might simply be neglected and allowed to become infested with invasive weeds associated with plantation forestry.

7.5.4 Environmental management in forestry: compliance and certification

7.5.4.1 Large owners

Forestry companies have been giving increasing attention to the quality of their environmental management. All the largest companies have appointed environmental managers over the last fifteen years, and these companies now have modest teams involved in environmental management. During the last decade each company developed and implemented its own environmental audit system, the auditors coming from local and regional staff as well as including interested external groups, such as representatives from conservation agencies.

More recently, Safcol and Mondi, and a few small charcoal operations, have been certified in terms of Forest Stewardship Council (FSC) (See Appendix B.2.4 for a discussion on the FSC) principles and criteria of sustainable forest management. These are international standards that incorporate all local laws, regulations and standards, and certification may only be done by one of five bodies accredited by FSC. The FSC standard inspects the environmental, economic and social sustainability of the forestry operation. It involves third party audits by professional auditors with international experience, backed up by local expertise in key fields. Certified timber growers are subject to re-surveillance twice a year after the initial assessment. Certification by FSC provides a market advantage, but at this stage this applies only to solid wood products.

Certification in terms of FSC principles would requires that all the environmental issues described above would have to be addressed in a way that is appropriate to the scale of operations and local conditions. For instance, biodiversity issues would be viewed differently in a situation where timber is being planted into old sugar cane lands rather than nearly natural grasslands. There is also a substantial requirement to monitor the important environmental impacts of the forestry operations, such as those on water. Certification is providing a strong motivation for the improvement of the quality of forest management in South Africa.

A weakness in the certification system is that external audits are forced to do a very small sampling, and poor practice may continue unless the company is sincere about improving its management. Secondly, the application of standards is made more difficult because specific and quantitative South African codes of practice, and criteria and indicators of sustainable management have not yet been developed.

Sappi is the second largest forestry company in South Africa, but their primary business is paper so they see little advantage in pursuing certification in terms of FSC (the certification of paper is still unclear). Instead, they have had their own operating system certified in terms of ISO-14001. This means that their environmental management system measures up against an international standard. The auditing against this set of operating procedures is done twice a year by the SABS (South African Bureau of Standards) at which stage compliance with the documentation and performance standards is checked.

7.5.4.2 Medium and small owners

This category includes a very large number of timber growers with varying amounts of forestry in what are commonly mixed farming operations. Environmental practices vary widely as can be expected. However, it should not be assumed that smaller operations necessarily have less interest in a high standard of environmental management. Many farmers pride themselves on taking better care of their land than the large enterprises because they have a personal and long-term interest in conserving their land resource, and, in many cases, because their management efforts are spread over a smaller land area.

For medium-size growers who are producing sawlog material there is also a market advantage to being certified. However, the cost of setting up a whole management system to satisfy the needs of FSC certification would probably be prohibitive for an individual grower of moderate size. For this reason NCT (NCT Forestry Co-operative Limited) has set up a management system for such owners as would like to become certified as part of a group. Around 25 medium-sized operations, with an aggregate plantation area of 15 000 to 20 000 ha and co-ordinated by NCT, will be assessed for FSC group certification under the NCT management system later this year. Once certification is gained, other NCT members will be able to join the group only once they can pass a second party audit, i.e. by NCT. All members of the group are subject to assessment by the external certifying body.

Any private timber grower that is a member of SATGA (South African Timber Growers Union) can volunteer to be audited against the >GEC standard= by SATGA. This is a second party audit (a SATGA regional committee with some co-opted external members) rates their environmental performance in terms of one to five stars. Members are encouraged to join this scheme which also aims to improve the environmental awareness of members and includes all environmental aspects of their farming operations. SAWGU also encourages its members to enter the SATGA environmental audit scheme, and their annual awards scheme is based on both consistently high productivity and a minimum of a four star SATGA environmental rating. To date roughly 150 private owners have had their forestry operations audited under the SATGA scheme. A pre-requisite for joining the NCT group wishing to be certified by FSC is that one is part of the SATGA environmental audit group.

SAWGU will be putting gentle pressure on its members who have an obviously poor record of clearing and managing their riparian zones.

7.5.4.3 Mini growers

The small grower schemes involve a loan of some form for the new growers. For this reason the sponsor is able to enforce fundamental environmental controls, linking the funding to legal practices. The extension forester employed by Sappi, Mondi or SAWGU visits the proposed planting site to check it for suitability and also to delimit boundaries around wetlands or riparian zones. The owners might, unofficially and at their own risk, extend their boundaries into these unplanted areas at a later stage. Leaving a 30 m wide unafforested strip around riparian zones could exclude a very large portion of a limited land allocation (up to 60 per cent of a 1 ha block - 100 m square - that straddles a stream). This unplanted area is unlikely to remain unused by a person with a very small allocation of land. Given the number of small growers and the small size of their holdings, there is little other than prior education to encourage compliance with sound environmental management principles.

In summary, although many non-market policy instruments and incentive schemes are used in the forestry sector, the potential for market based instruments in current proposals for the new Forestry Act are not adequately considered. In community forestry the focus should rightly be on the institutional context first, but in the case of commercial forestry the possibility of economic policy instruments need to be attended to.

7.6 Economic Policy Instruments

Economic policy instruments to environmental utilise economic incentives or market stimuli to reach environmental objectives (OECD 1994:15). Targeted economic policies can generally be divided in three areas, namely, removing existing market distortions, internalising the externalities (ie >getting he prices right=) and structural macroeconomic reforms (Norgaard 1997).

7.6.1 Removing current distortions

Although many government interventions (subsidies, taxes, tariffs, quotas, grandiose public investments) are made with the intention of improving social welfare, many times the opposite is true. Government expenditures often take the form of subsidies. A subsidy is any measure that keeps prices for consumers below the market level or keeps prices for producers above the market level, or that reduces costs for consumers and producers by giving direct or indirect support. Subsidies can give wrong signals on production and consumption leading to an unsustainable use of natural and environmental resources. Many current subsidies encourage wasteful behaviour and are instrumental in environmental degradation.

The ideal approach would be to internalise water externalities in the forestry sector, after the policy failures on a macroeconomic level have been addressed (after Harou et al 1994). It is recognised that the alignment of different policy processes are complicated in practice. A full analysis of policy failures in the forestry sector is beyond the scope of this paper.

7.6.2 Internalising the externalities

Before externalities can be internalised, it must be clear who owns the rights or plights regarding these externalities. With the new Water Act the National Government owns all water rights, the rights on biodiversity and carbon sequestration are less well-defined and would vary greatly across geographical areas. For the latter two international conventions are acting as relatively weak definitions of property rights. A tightening of ownership of biodiversity loss is also possible on a national or regional level, when EIAs and other Integrated Environmental Management procedures include the management of plantations with active conservation and promotion of a full range of biodiversity as a priority (Allan et al 1998:183). As pointed out by Simula (1998:5), the benefits of carbon sequestration can be quantified with the use of proxies, but in the case of biodiversity only parts of the benefits lost are quantifiable in economic terms. The policy relevance is that government would be able to internalise water use through the use of domestic market-based instruments, but in the case of biodiversity and carbon sequestration the global and national/regional institutional context is in the process of being defined (eg. Kyoto mechanisms in the case of carbon rights).

7.6.2.1 Water use externalities

Economic policy responses to water use centre around charging for water, i.e. water user charges, and trading of water rights. In South Africa, the political process is dictating the water price at this stage, with no clear reference to the marginal cost of water as a guide in the setting of charges (DWAF 1998c; CSIR 1999). Water charges are calculated on the basis of the expected management costs of catchment management agencies and not on the criterion of economic efficiency. The opportunity cost approach presented earlier in this study is an attempt to illustrate the implications of economically based water use charges and not politically based water use charges. Two points:

< These approaches do not take account of the true social costs of water. If prices are set too low, there will be no incentive for conservation, and if prices are set to high, economic inefficiencies will occur (see Tietenberg 1996 for a discussion on water pricing and economic efficiency).

< Politically based water user charges in the forestry sector will not internalise the social cost to the environment, but will be used to fund CMAs. The efficiency of CMAs in internalising some of the social costs will ultimately determine whether these charges are successful.

7.6.2.2 Ecosystem services: biodiversity and carbon

Only specific parts of biodiversity are quantifiable in economic terms, implying a risk of underplaying biodiversity values in management decisions. Chichilnisky & Heal (1999) argue that examples of ecosystem services that might be privatised (i.e. have market values attached) are watershed and carbon sequestration services, preservation of wild animals as a basis for ecotourism, and pollination. In cases where ecosystem services cannot be valued in monetary values the environmental economic policy literature recommends the use of safe-minimum standards or absolute standards, and an economic analysis how to achieve these standards as cost-efficiently as possible (see Gowdy 1997 for an application to biodiversity loss). The economic value of carbon sequestration provides the basis for a potential future institutional market in carbon rights.

7.6.3 Structural macroeconomic reform

With the focus on sustainable development, which is ultimately concerned with intergenerational equity, the environmental economic focus on >getting the prices right= or fine-tuning the economy at the margin, have proved inappropriate (Norgaard 1997). Recent literature in the fields of ecological and environmental economics have pointed out that the efficiency criteria (i.e. internalising externalities) are a necessary, but not sufficient condition to reach a path of sustainable development (Hediger 1997).

Without discussing these instruments in detail, one should take cognisance of the drive towards macroeconomic structural reform, when modelling the linkages between the economy and the environment. This drive manifests itself primarily through environmental tax reform (i.e. taxing the >bads=, such as pollution, exploitative use of resources, and reducing taxes on the >goods=, such as labour and income. Another innovation is the design of economic instruments that minimises the throughput of materials through the economy (Daly 1996)

8. CONCLUSIONS AND RECOMMENDATIONS

It can be concluded that forestry does have negative and positive environmental impacts. Forestry water use does have an impact on South Africa=s water resources, comprising more than 7 per cent of the total amount of water used. The social opportunity cost of this water lies in a wide range, depending on the downstream economic demand for water. More work is needed in the estimation of social opportunity costs through refining the downstream spatial distribution of economic activities. The estimates of social opportunity costs in this study, however, point out that even in case of full internalisation of social opportunity costs, forestry is an economically viable option when compared to irrigated agriculture, dryland agriculture and environmental land-uses. This is not the case when compared to urban and domestic economic activities.

It is recommended that forestry take notice of the potential benefits of carbon sequestration on international markets for carbon rights. These benefits could be in the order of tens of millions of rands. The international negotiations on the Kyoto Mechanisms (Joint Implementation, Clean Development Mechanism and International Emissions Trading) are currently continuing.

Apart from regulatory approaches to forestry, the possibility for market-based instruments, such as water charges, could be considered. Once the political decision has been made, such instruments are relatively efficient to obtain economic objectives of the internalisation of water use externalities. These instruments should, however, not be implemented in the absence of a well-defined institutional context and without (ideally) prior removal of current market distortions. The relationship between >getting the prices right= and structural macroeconomic reform is highlighted as an area where this paper did not pay adequate attention to, but certainly of importance to the broader debate on the macro-economy and sustainable development.

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APPENDIX A: NON FOREST AND FOREST RELATED INTERNATIONAL FRAMEWORKS

A.1 Non-forest related international policy frameworks

A.1.1 United Nations

A.1.1.1 Agenda 21

The United Nations Conference on Environment and Development (UNCED) Agenda 21 Programme was the action document coming out of the >Earth Summit= in Rio de Janeiro in 1992 where the leaders of 178 nations gathered. The need to reconcile the productive functions with the protective, environmental and social roles of forests was forcefully stressed in Agenda 21 - Chapter 11 on Combating Deforestation.

A.1.1.2 Convention on Biological Diversity

This UNCED agreement recognises the broader role that forests play in the maintenance of global ecosystems, although it fails to address forest loss directly.

A.1.1.3 Framework Convention on Climate Change

In the context of this UNCED agreement, especially the Kyoto Protocol, forests have become a factor in joint implementation agreements because of their important role in regulating Earth=s temperature. When two countries enter into a joint implementation agreement, one country pays another to either reduce its emissions of greenhouse gases or to absorb them through sequestration. Hence, certifying forests and verifying claimed levels of carbon dioxide absorption will become a key area for forestry policy development in the near future.

A.1.1.4 Food and Agriculture Organisation of the United Nations (FOA)

In May 1993, the FOA announced the convening of a high-level meeting of ministers responsible for forestry matters to >provide a global forum to harmonize initiatives underway in forestry=. The meeting was held in Rome in March 1994 in conjunction with the session of the FOA Committee on Forestry and was an opportunity for ministers with forestry portfolios (mostly Ministers of Agriculture) to meet before the April 1995 Commission on Sustainable Development review of forests, which was attended by ministers and senior officials of environment and foreign affairs. In October 1997, the FOA hosted the XI World Forestry Congress in Turkey and continues to play a central role in giving policy input to the international forestry sector.

A.1.2 Environmental management voluntary standards

A.1.2.1 BS7750, EMAS and ISO 14001 and

BS7750 (a British standard), the European Eco-Management and Auditing Scheme (EMAS) and the ISO 14001 Environmental Management System (EMS) Standard are all international, certifiable schemes which intend to give assurance that companies have an environmental management system in place which results in continuous improvement of environmental performance. Since its launch in 1996, the ISO standard has become the more popular global standard to be adopted.

The limitation of BS7750, EMAS and ISO 14001 for the forestry sector (indeed all sectors) is that it is a generic systems / process standard rather than a specific performance standard. Hence, it does not give guidance on or assess actual forest management practices on the ground, nor are there any minimum benchmarks for aspects of the sector=s activities (eg watershed management, biodiversity conservation, soil disturbance and the use of chemicals) or products (eg eco-labels). Meaningful comparison between companies is therefore difficult.

These EMS standards should therefore be seen as complementary to other forestry-specific certification schemes, rather than substitutes.

A.1.2.2 Other voluntary environmental management standards

Numerous other principles, guidelines, codes and standards have been issued and adopted by companies around the world. For example:

< The Coalition for Environmentally Responsible Economies (CERES) Principles (formerly the Valdez Principles), issued in 1991; and

< The International Chamber of Commerce >Business Charter for Sustainable Development=, launched at the Second World Industry Conference on Environmental Management in 1991. By early 1992, 600 firms worldwide had endorsed the Charter.

These and other generic guideline documents share the same limitations for the forestry sector as the EMS standards described above.

A.1.3 Other Non-Governmental Initiatives

A.1.3.1 World Resource Institute (WRI)

The WRI has taken an active interest in the forestry sector and is a key source of information and policy input on this critical natural resource. For example, its *World Resources 1996-97* has a dedicated chapter on Forests and Land Cover (Chapter 9) which addresses issues such as the State of the World=s Forests, Forests and Economic / Trade Policy, Forest Policy Instruments, New International Forest Policy Initiatives and Principles for a Global Agreement on Forests.

WRI=s website can be found on the Internet at http://www.igc.org/wri/.

A.1.3.2 Worldwide Fund for Nature (WWF)[3]

WWF=s Forests for Life Campaign was launched in October 1995 with two main targets:

< To establish an ecologically representative network of legally protected areas covering at least 10 per cent of the world=s forests by the year 2000; and

< To see independent certification of at least 10 million hectares of well-managed forest, based on sound social ecological and economic criteria by 1999. This was achieved in June 1998 and a second target of 25 million hectares by 2001 has been set.

Based on the success achieved by this campaign, largely due to the work of the FSC-based certification, WWF launched the >Global Forestry and Finance Initiative in September 1998, with two aims in mind:

< To inform investors about recent efforts to raise forest management standards, which seek to ensure healthy forests for future generations; and

< To show how companies adopting high standards in forest management can gain commercial advantage.

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3 Investing in tomorrow=s forests, by R Crossley and J Points.

A.2 Forest-related international policy frameworks[4]

A.2.1 UNCED

Ecologically sustainable and socially responsible management of forests was clearly emphasised in the >Forest Principles= (ie the >Non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests=), which formed part of the Report of UNCED (Annex III).

A.2.2 Intergovernmental Panel on Forests (IPF)

The Open-End Ad Hoc IPF was approved during the third session of the UN Commission on Sustainable Development (UNCSD) The UNCSD created IPF to generate consensus and propose actions for the implementation of UNCED=s forest-related agreements at the national and international levels. Such agreements could cover a multitude of issues including:

< cross-sectoral linkages.
< the transfer of financial and technological resources through international co-operation.
< scientific research, global forest assessment, and criteria and indicators for sustainable forest management.
< trade and environment in relation to forest products and services.
< the roles of international organisations, multilateral institutions and legal instruments.

A.2.3 World Commission on Forests and Sustainable Development (WCFSD)

The independent WCFSD received a formal mandate from the InterAction Council of Former Heads of State and Government and is designed to complement the IPF. WCFSD does not plan to produce a specific international instrument. Rather, it hopes to generate consensus and resolve conflict on:

< the dual role of forests in preserving natural habitats and promoting socio-economic development.
< the linkages between data, science and policy.
< the importance of co-operation between developed and developing countries in determining priorities on forest issues.

[4] Sources include: World Resources 1996-97 (Chapter 9 on Forests and Land Cover), WRI.

A.2.4 Forest Stewardship Council (FSC)

FSC is an assembly of NGOs, industry representatives, scientists and indigenous peoples, established in 1993 to promote the environmentally appropriate, socially beneficial, and economically viable management of the world=s forests. In 1994, FSC adopted a set of principles and criteria for the sustainable management of forests, as well as guidelines on how to conduct field inspections and verify the chain of custody of certified forest products. In 1995, FSC developed a rigorous framework for the evaluation, accreditation and monitoring of organisations that issue certification claims in the marketplace, as well as guidelines for developing regional forest management standards and a protocol for endorsing national certification initiatives. National initiatives based on the FSC guidelines are under development in more than 12 countries, ranging from Brazil to Sweden to Indonesia.

APPENDIX B: INTERNATIONAL POLICY DEVELOPMENTS IN CRITERIA AND INDICATORS[5]

One of the areas in which international policy development has made significant progress is in the identification of Criteria and Indicators of sustainable forest management. These developments are introduced below.

B.1 International declarations and recommendations

Several international meetings since UNCED have made declarations and recommendations related to the development of criteria and indicators, including the following:

< the >Bandung Declaration=, arising from >The Global Forest Conference=, organised by the Government of Indonesia (February 1993);

< the two meetings of the >Intergovernmental Working Group on Global Forests= sponsored jointly by the Governments of Malaysia and Canada (April 1994, October 1994);

< the >New Delhi Resolution= passed by the international workshop >Towards Sustainable Forestry: preparing for the Commission on Sustainable Development 1995=, organised by India and the UK (July 1994);

< conclusions and recommendations of the workshop, >Science, Forests and Sustainability - a policy dialogue=, organised jointly by the Government of Indonesia and the Centre for International Forestry Research (CIFOR) (December 1994);

< conclusions and recommendations of the Intergovernmental Seminar on Criteria and Indicators for Sustainable Forest Management, organised by the Government of Finland in collaboration with FAO in Helsinki (August 1996); and

< the Japan/Canada >International Workshop on integrated Application of Sustainable Forest Management Practices=, organised in collaboration with FAO and ITTO among others, in Japan (November 1996).

B.2 Intergovernmental initiatives

In addition to these international initiatives, various intergovernmental activities have been conducted mainly within the framework of a number of major international initiatives. These are described briefly below.

B.2.1 The Helsinki Process

The >Helsinki Process= (officially entitled >The European Process on Criteria and Indicators for Sustainable

10 State of the World=s Forests, 1997, pp.116-124.

Forest Management=) focuses on the development of criteria and indicators for European forests, which include boreal, temperate and Mediterranean-type forests. The mandate of the process was laid down in two Ministerial Conferences on the Protection of Forests in Europe (Strasbourg 1990, Helsinki 1993). The European countries have agreed upon six common criteria, 27 quantitative indicators, and a number of descriptive indicators for sustainable forest management.

B.2.2 The Montreal Process

The >Montreal Process= was initiated in the follow-up to the Seminar of Experts on Sustainable Development of Temperate and Boreal Forests, organised in Montreal, Canada in 1993 within the framework of the Conference on Security and Co-operation in Europe (CSCE). The initiative deals with criteria and indicators in temperate and boreal forests outside of Europe. The ten countries originally participating, plus an additional two which have recently become involved, have agreed on a set of seven, non-legally binding criteria and 67 indicators for sustainable forest management, identified for national implementation.

B.2.3 The Tarapoto Proposal

The >Tarapoto Proposal of Criteria and Indicators for Sustainability of the Amazon Forest=, was adopted in February 1995 in Tarapoto, Peru, in a meeting held under the auspices of the Amazon Co-operation Treaty. Within the framework of this initiative, seven criteria and 47 indicators were identified and proposed formation level implementation in the eight participating countries. Criteria and indicators were also identified for the forest management unit level (an additional four criteria and 22 indicators) and for the global level (one additional criterion and seven indicators). The recommendations and conclusions of the meeting have been submitted to the governments of participating countries for their approval and ratification.

B.2.4 Dry-Zone Africa Process

The UNEP/FAO Expert Meeting on Criteria and Indicators for Sustainable Forest Management in Dry-Zone Africa, was held in Nairobi, Kenya 21 - 24 November 1995 The meeting identified seven criteria and 47 indicators which have been presented to the subsequent session of the African Forestry and Wildlife Commission, and submitted to the concerned 27 countries and to Secretariats of three sub-regional groupings (permanent Interstate Committee for Drought Control in the Sahel - CILSS, intergovernmental Authority on Development - IGAD, Southern African Development Community - SADC) for review, comments, agreements and subsequent follow-up. **This would appear to be the most relevant initiative for South Africa.** However, time and cost constraints did not allow more detailed research in this direction as part of the current assignment.

B.2.5 Near East Region Process

The FAO/UNEP Expert Meeting on Criteria and Indicators for Sustainable Forest Management in the Near East Region, was held from 15-17 October 1996 in Cairo, Egypt Seven criteria and 65 indicators were proposed by the experts and were presented immediately thereafter to the member states of the Near East Forestry Commission in its 12th Session, which met from 21-24 October 1996 also in Cairo The Commission endorsed this set of criteria and indicators and accepted them as a >good working document and a working draft= which would have to be tested in each country of the region.

B.2.6 The Central American/Lepaterique Process

An Expert Meeting on Criteria and Indicators for Sustainable Forest Management in Central America organised by FAO, in collaboration with the Central American Commission for Environment and Development *(Comisión Centroamericana de Ambiete y Desarrollo, CCAD0)*, was held in Tegucigalpa, Honduras, from 20-24 January 1997. Cuba also attended the meeting in observer capacity. The meeting, which launched >The Central American/Lepaterique Process=, identified 4 criteria and 40 indicators for regional level, and 8 criteria and 52 indicators for the national level. It drafted a declaration related to the sustainable management of the region=s forests, which will be presented to the Summit of Presidents of the CCAD countries in March 1997 for consideration by Heads of State.

B.3 Organisation-specific initiatives

The most important of these is the forestry Stewardship Council (FSC). The FSC, as previously mentioned, is an international body which accredits certification organisations in order to guarantee the authenticity of their claims. In all cases the process of certification will be initiated voluntarily by forest owners and managers who request the services of a certification organisation. Certification is based on compliance with the FSC=s Principles and Criteria. The Principles are briefly listed below.

< Compliance with laws and the FSC principles.
< Tenure and use rights and responsibilities.
< Indigenous people=s rights.
< Community relations and worker=s rights.
< Benefits from the forest.
< Environmental impact.
< Management plan.
< Monitoring and assessment.

< Maintenance of natural forests.

< Plantations.

In order to be considered for certification, all forests, including plantations, must meet Principles and Criteria 1 through 9. Plantations, however, must also satisfy Principle 10 and its Criteria. A full disclosure of the Principles and Criteria can be accessed on the Internet at http://www.fscus.org/

The claimed benefits of certification under the FSC scheme are:

< Improved quality, productivity and ensuring the right to operate - including assurance of a long-term supply of timber because forests do not become exhausted and lose their productive capacity.

< Better market share, sales and prices - including tapping latent consumer demand.

< Improved reputation with consumers, employees and local communities - enabling them to focus their efforts on productive management issues rather than environmental conflicts.

< Reduction in risk - resulting in lower costs of capital and insurance premiums.

APPENDIX C: INDICATORS FOR FUTURE FORESTRY POLICY

C.1 A snapshot of international forestry policy in 1999

In a detailed special review in the internationally renowned global business and environment magazine *Tomorrow*, a profile for various sectors was created for *The State of Green Business 1999*. The section on Forestry, which is included in Table 5 below, is indicative of the kinds of international policy trends evident in the industry at present.

Table C.1: The State of Green Business 1999: Forestry[6]

Overall assessment	*1998 Milestones*	*Outstanding Issues*	*Key Challenges*
♉ Progress in certification this year, with a significant uptake of Forestry Stewardship Council (FSC) labelling and emergence of the first industry-led pan-European competitor scheme. ♉ Clear-cutting and conservation of old growth forests still made headlines, but awareness of the social aspects of forestry is emerging. ♉ 1999 expect keen interest in carbon sequestration, watershed protection and intensifying debate over genetically modified tree species.	♉ Swedish regional FSC criteria agreed upon. ♉ Cross-sectoral outline agreement reached on UK Forest Audit Protocol. ♉ Finnish Certification System (FFCS) launched as first industry-led, regional alternative scheme to FSC. ♉ MacMillan Bloedel=s creation of an >Old Growth Zone= and decision to phase out clear-cutting in British Columbia. ♉ By end 1998, SCA planned to have FSC-certified 2 m hectares. ♉ Western Forest Products (WFP) and Interfor criticised for clear-cutting in the Great Bear Rainforest.	♉ Kyoto flexible mechanisms and emissions trading. ♉ Carbon sequestration and offset certification. ♉ Forest products certification. ♉ Watershed protection, biodiversity and conservation and old growth and unique forests. ♉ Social and community aspects of forest planning. ♉ Clear-cutting. ♉ Genetically modified trees.	♉ Harnessing the market potential of non-timber forestry products such as carbon sequestration and biodiversity. ♉ Ensuring socially and economically viable conservation of unique types of forests worldwide.

C.2 Emerging initiatives

There are two initiatives which are further indicative of things to come in the international policy development arena. These are briefly mentioned below.

11 Tomorrow magazine, January/February 1999, p.23.

C.2.1 Forest Resource Accounting

Following the initiative of the International Institute for Environment and Development (IIED) and the World Conservation Monitoring Centre (WCMC), with financial support from Britain=s Department for International Development (DFID), a new concept of Forest Resource Accounting is emerging. Forest Resource Accounting is an approach to gathering information about forests and how they are managed which encourages everyone who has a stake in forests, to participate. Pilot projects have already been launched in Guyana, Ecuador and Pakistan.

C.2.2 Global Forest Resources Assessment 2000

Building on past experience and looking toward future requirements, the FAO and the Economic Commission for Europe (UN-ECE), in collaboration with various national institutes and a range of international organisations, are preparing for the Global Forest Resources Assessment 2000. This is expected to form the new benchmark for managing forests internationally.